

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

CYTONOME/ST, LLC,)	
)	
Plaintiff,)	
)	
v.)	C.A. No. 19-301 (RGA)
)	
NANOCELLECT BIOMEDICAL, INC.,)	
)	
Defendant.)	

JOINT APPENDIX IN SUPPORT OF JOINT CLAIM CONSTRUCTION BRIEF

Description	Exhibit
Plaintiff's Proposed Construction of Claim Terms and Phrases, dated October 25, 2019	A
Document bearing Bates numbers NANO_00009720 – NANO_00009721	B
Document bearing Bates number NANO_00009722	C
Document bearing Bates number NANO_00009723	D
Plaintiffs' List of Claim Terms That Require Construction, dated October 11, 2019	E
Document bearing Bates numbers CYTLLC_001256 – CYTLLC001555	F
Document bearing Bates numbers NANO_00009724 – NANO_009748	G
Declaration of Dr. Giacomo Vacca in Support of Plaintiff's Reply	H
'528 Patent Prosecution History – 6/22/2004 Office Action	I
Merriam-Webster.com – Definition of Buffer	J
Declaration of Dr. Dino Di Carlo in Support of Defendant's Sur-Reply	K

EXHIBIT A

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Plaintiff,)	
)	
v.)	C.A. No. 19-301 (RGA)
)	
NANOCELLECT BIOMEDICAL, INC.,)	
)	
Defendant.)	

PLAINTIFF’S PROPOSED CONSTRUCTIONS OF CLAIM TERMS AND PHRASES

Pursuant to Paragraph 8 of the Scheduling Order (D.I. 15), Plaintiff Cytonome/ST, LLC (“Cytonome”) serves on Defendant NanoCollect Biomedical, Inc. (“NanoCollect”) its proposed construction of claim terms and phrases. As an initial matter, Cytonome objects to NanoCollect’s identification of sixty-two terms as excessive and unreasonable. For nearly every term identified by NanoCollect, no construction is needed, and the term’s plain and ordinary meaning should be applied. To the extent NanoCollect plans to generate a “dispute” for dozens of terms that do not need a formal construction, this will unnecessarily waste the parties’ and the Court’s time. NanoCollect should limit its proposed terms to those for which it foresees a genuine dispute requiring resolution from the Court.

Subject to the foregoing objection, Cytonome identifies the following proposed constructions for the claim terms/phrases identified by the parties for construction. For the terms/phrases for which construction is not required, Cytonome indicates as such by stating “Plain and ordinary meaning” or “Otherwise, the plain and ordinary meaning should be applied.” Cytonome reserves the right to amend these proposed constructions or to offer a construction in lieu of “plain and ordinary meaning” based on NanoCollect’s disclosure of its proposed constructions, or as may be occasioned by any other development in the litigation.

I. Constructions for Cytonome's Proposed Terms/Phrases

Cytonome's Proposed Terms/Phrases	Cytonome's Proposed Constructions
"reservoir" '528 cls. 1, 7, 9, 17, 25, and 26 '295 cl. 1 '797 cls. 1, 5, 18 '263 cls. 1, 5, 15, 16, 19, 20	"a physical structure that contains fluid"
"buffer" '528 cls. 18, 22, 24 and 26 '850 cl. 1, 4, 5, 9, 11, 12	"a physical structure that contains fluid capable of absorbing or dampening pressure"
"fluid" '528 cls. 1, 2, and 17 '295 cls. 5–8, 11–15 '797 cl. 5 '263 cl. 7, 21 '850 cls. 9–11 '283 cls. 1, 4, 5	"a liquid or a gas"
"generating," "generated" and variations '295 cl. 1 '797 cl. 14 '263 cl. 1	"creating," "created"
"originating" and variations '263 cls. 5, 16, 17, 20, and 21	"creating"
"chamber" '850 cls. 3, 4, 10, 11 '283 cls. 1, 5, 6	"a physical structure that contains fluid"
"a unique identifier" '188 cl. 11	"a unique label, such as a barcode, that renders an object fully traceable"

II. Constructions for NanoCollect's Proposed Terms/Phrases

NanoCollect's Proposed Terms/Phrases	Cytonome's Proposed Constructions
"actuator" '528 cls. 1, 2, 4, 8, 10, 11, 17, 18, 22, 23, 25 '295 cl. 2 '797 cl. 13 '850 cls. 1-3, 10 '263 cls. 2, 8, 12, 15, 19 '283 cls. 1, 2 '188 cls. 1, 12, 15	Plain and ordinary meaning
"regulating" and variants "regulate" '528, cls. 1, 2, 10	Plain and ordinary meaning
"valve" '528 cls. 1, 17	Plain and ordinary meaning
"absorbing" and variants including "absorbs" '528 cls. 1, 9, 17, 18, 22 '295 cls. 1, 4, 9 '797 cls. 1, 3-7, 12, 18 '850 cl. 1 '263 cls. 1, 15, 19 '188 cls.	Plain and ordinary meaning
"induced" '528 cl. 1	Plain and ordinary meaning
"deflect" and variants "deflectable," "deflection," "deflecting" '528 cls. 2, 8, 10, 17, 18, 20, 22 '295 cls. 16, 17 '850 cls. 1, 3 '188 cls. 1, 12, 17	Plain and ordinary meaning
"generate" and variants "generated," "generating" '528 cl. 4 '263 cls. 1, 15, 19 '188 cls. 12, 17	"create," "created," "creating"
"movable membrane" '528 cls. 7, 8	Plain and ordinary meaning

“flexible membrane” ’528 cls. 9, 10, 23, 24 ’295 cl. 17	Plain and ordinary meaning
“a second plate for enclosing the microchannel bonded to the first plate” ’528 cl. 9	Plain and ordinary meaning
“bubble valve” ’528 cl. 17	“a device that generates pressure pulses to control flow through a channel”
“stream of particles” ’528 cls. 17, 18, 20, 22 ’850 cl. 1 ’263 cls. 1, 13-15, 19 ’188 cls. 1, 12	Plain and ordinary meaning
“carrier fluid” and variants “carrier liquid” ’528 cls. 17, 18, 22 ’850 cl. 3	“a sheath of compatible liquid surrounding a particle for carrying one or more particles through a duct or channel”
“pressure pulse” ’528 cls. 17, 18, 19, 22 ’295 cls. 1-4, 9, 10 ’797 cls. 1-5, 7, 12-16, 18, 19 ’850 cls. 1, 7, 8, 12 ’263 cls. 1, 5, 6, 15, 16, 19, 20 ’188 cls. 1, 12, 17	Plain and ordinary meaning
“from the stream of particles” ’528 cls. 17, 18, 22 ’188 cls. 1, 12	Plain and ordinary meaning
“the side channel” ’528 cl. 17 ’850 cl. 3 ’263 cl. 18	Plain and ordinary meaning
“buffer” ’528 cls. 18, 22, 24, 26 ’850 cls. 1, 4, 5, 9, 11, 12	“a physical structure that contains fluid capable of absorbing or dampening pressure”
“for selectively applying” ’528 cl. 18 ’850 cl. 1	Plain and ordinary meaning

<p>“a first side channel”</p> <p>’528 cl. 22</p>	<p>Plain and ordinary meaning</p>
<p>“in communication”</p> <p>’528 cls. 17, 22</p> <p>’850 cls. 3, 4</p>	<p>Plain and ordinary meaning</p>
<p>“sealed reservoir”</p> <p>’528 cls. 25, 26</p>	<p>A “sealed reservoir” is a reservoir that is in communication with the primary channel but is otherwise sealed from an external environment.</p> <p>A reservoir is “a physical structure that contains fluid.”</p>
<p>“a second reservoir for absorbing a pressure variation in the microchannel induced by the actuator”</p> <p>’528 cl. 1</p>	<p>A reservoir is “a physical structure that contains fluid.”</p> <p>Otherwise, the plain and ordinary meaning should be applied.</p>
<p>“generates a gas bubble”</p> <p>’528 cl. 4</p>	<p>“creates a gas bubble”</p>
<p>“a second reservoir formed on a second side of the groove opposite the first reservoir for absorbing pressure variations in the groove”</p> <p>’528 cl. 9</p>	<p>A reservoir is “a physical structure that contains fluid.”</p> <p>Otherwise, the plain and ordinary meaning should be applied.</p>
<p>“an actuator connected to the first side channel”</p> <p>’528 cl. 22</p>	<p>Plain and ordinary meaning</p>
<p>“the actuator comprises air trapped in a sealed reservoir”</p> <p>’528 cl. 25</p>	<p>A reservoir is “a physical structure that contains fluid.”</p> <p>A “sealed reservoir” is a reservoir that is in communication with the primary channel but is otherwise sealed from an external environment.</p> <p>Otherwise, the plain and ordinary meaning should be applied.</p>
<p>“a first reservoir operatively associated with the flow channel and adapted for dampening or absorbing a pressure pulse propagated across the flow channel”</p>	<p>A reservoir is “a physical structure that contains fluid.”</p> <p>Otherwise, the plain and ordinary meaning should be applied.</p>

'295 cl. 1	
"dampening or absorbing the pressure pulse using a first reservoir in fluid communication with the microfluidic flow channel"	A reservoir is "a physical structure that contains fluid."
'797 cl. 1	Otherwise, the plain and ordinary meaning should be applied.
"operatively associated"	Plain and ordinary meaning
'295 cls. 1, 2 '797 cls. 13, 14 '263 cls. 5, 15, 16, 20	
"dampen" and variants "dampening"	Plain and ordinary meaning
'295 cls. 1, 4, 9 '797 cls. 1, 3-7, 12, 18 '850 cl. 1 '263 cls. 1, 15, 19	
"propagated" and variants "propagating"	Plain and ordinary meaning
'295 cl. 1 '797 cl. 5 '263 cls. 1, 15, 16, 19	
"pressurizer"	Plain and ordinary meaning
'295 cl. 2 '797 cl. 13	
"resilient wall"	Plain and ordinary meaning
'295 cl. 9 '797 cls. 4, 12	
"facilitate"	Plain and ordinary meaning
'295 cls. 1, 10 '797 cls. 3, 5, 7, 15	
"otherwise sealed" and variants "otherwise sealed from"	A reservoir or chamber that is "otherwise sealed" is a reservoir that is in communication with the flow channel (or duct) but is otherwise sealed from an external environment.
'797 cl. 5 '283 cls. 1, 6	
"resilient properties"	Plain and ordinary meaning
'797 cls. 6, 7, 12	
"configured to fluidically co-operate with the actuator"	Plain and ordinary meaning

'850 cl. 1	
“a sealed chamber positioned adjacent to the side channel, wherein the carrier liquid forms a meniscus in the side channel to separate the sealed chamber from the carrier liquid”	A chamber is “a physical structure that contains fluid.”
'850 cl. 3	A “sealed chamber” is a chamber that is in communication with the duct but is otherwise sealed from an external environment.
	Plain and ordinary meaning
“modifying”	Plain and ordinary meaning
'850 cl. 3	
“movable wall”	Plain and ordinary meaning
'850 cl. 5	
“switching device”	Plain and ordinary meaning
'263 cls. 1, 2, 5–8, 12, 13, 19–21	
“operatively coupled”	Plain and ordinary meaning
'263 cls. 1, 19	
“from the fluidic stream of particles”	Plain and ordinary meaning
'263 cls. 1, 14, 19	
“upstream”	Plain and ordinary meaning
'850 cl. 9	
'263 cls. 1, 13, 15, 19	
'283 cls. 1, 5	
“downstream”	Plain and ordinary meaning
'263 cls. 1, 15, 16, 19	
“integrally provided on”	Plain and ordinary meaning
'263 cls. 2, 12	
“activate” and variants “activated”	Plain and ordinary meaning
'263 cls. 1, 2, 12, 15	
“originate” and variants “originating”	Plain and ordinary meaning
'263 cls. 5, 16, 20	
“external actuator”	Plain and ordinary meaning
'263 cls. 2, 12	
“operatively engage”	Plain and ordinary meaning

'263 cl. 12	
"pressure wave"	Plain and ordinary meaning
'263 cls. 13, 15	
"switch component" and variants "switch element"	Plain and ordinary meaning
'263 cls. 15, 17, 18 '188 cl. 11	
"deactivating"	Plain and ordinary meaning
'263 cl. 15	
"flexing"	Plain and ordinary meaning
'263 cl. 17	
"not a flow through channel"	Plain and ordinary meaning
'263 cl. 18	
"non-flow-through chamber"	A chamber is "a physical structure that contains fluid."
'850 cls. 10, 11	Otherwise, the plain and ordinary meaning should be applied.
"microsorter having a switching region and a microfluidic channel formed in the microfluidic chip fluidically coupled to a sample input a keep output, a waste output, and the switching region"	plain and ordinary meaning
'188 cl. 1	
"wherein the switching region, when actuated by the actuator upon detection of a predetermined characteristic of a selected particle, directs a pressure pulse across the microfluidic channel to deflect the selected particle from the stream of particles"	Plain and ordinary meaning
'188 cl. 1	
"the microfluidic chip including at least one microsorter having a switching region, and a microfluidic channel formed in the microfluidic chip fluidically coupled to a sample input a keep output, a waste output, the switching region"	Plain and ordinary meaning
'188 cl. 12	

“fluidically coupled” ’188 cls. 1, 12, 17	Plain and ordinary meaning
“external to the microfluidic chip” and variants “external to the particle processing assembly,” “external to the microfluidic particle sorting component” ’188 cls. 1, 12, 17	Plain and ordinary meaning
“operatively interfacing” ’188 cls. 17, 19	Plain and ordinary meaning

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October 25, 2019

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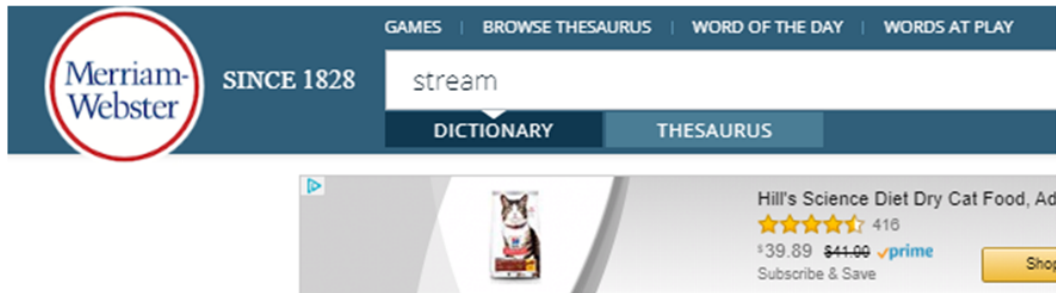
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EXHIBIT B

<https://www.merriam-webster.com/dictionary/stream>



stream noun

Save Word

\ 'strēm \

Definition of *stream* (Entry 1 of 2)

- 1 : a body of running water (such as a river or creek) flowing on the earth
also : any body of flowing fluid (such as water or gas)
- 2
 - a : a steady succession (as of words or events)
// kept up an endless *stream* of chatter
 - b : a constantly renewed or steady supply
// a *stream* of revenue
 - c : a continuous moving procession
// a *stream* of traffic
 - d : digital data (such as audio or video material) that is continuously delivered one packet at a time and is usually intended for immediate processing or playback
// Having proved their popularity with American couch potatoes, digital video recorders (DVRs) are about to get a boost in features that will allow them to zap several video *streams* throughout networked homes.
 — Ed Frauenheim
- 3 : an unbroken flow (as of gas or particles of matter)
- 4 : a ray of light
- 5
 - a : a prevailing attitude or group
// has always run against the *stream* of current fashion
 - b : a dominant influence or line of development
// the influence of two *streams* of inheritance: genetic and cultural
 — P. B. Baltes
- 6 *British* : [TRACK](#) sense 5c

NANO_00009720

Cytonome/ST, LLC Exhibit 2019

NanoCollect Biomedical, Inc. v. Cytonome/ST, LLC, IPR2020-00548

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stream verb

streamed; streaming; streams

Definition of *stream* (Entry 2 of 2)

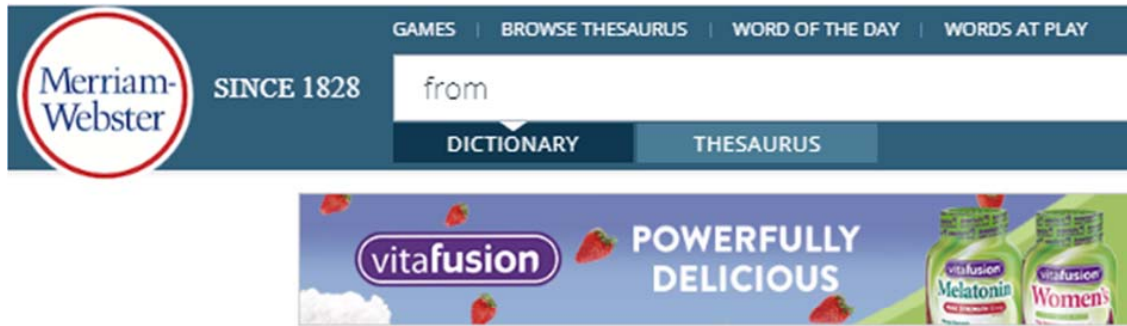
intransitive verb

- 1 a** : to flow in or as if in a stream
b : to leave a bright trail
// a meteor *streamed* through the sky
- 2 a** : to exude a bodily fluid profusely
// her eyes were *streaming*
b : to become wet with a discharge of bodily fluid
// *streaming* with perspiration
- 3** : to trail out at full length
// her hair *streaming* back as she ran
- 4** : to pour in large numbers
// complaints came *streaming* in

transitive verb

- 1** : to emit freely or in a stream
// his eyes *streamed* tears
- 2** : to display (something, such as a flag) by waving
- 3** : to transfer (digital data, such as audio or video material) in a continuous stream especially for immediate processing or playback

EXHIBIT C



from preposition



\ 'frəm ˌfrām also fəm \

Definition of *from*

- 1 **a** —used as a function word to indicate a starting point of a physical movement or a starting point in measuring or reckoning or in a statement of limits
// came here from the city
// a week from today
// cost from \$5 to \$10
- b** —used as a function word to indicate the starting or focal point of an activity
// called me from a pay phone
// ran a business from her home
- 2 —used as a function word to indicate physical separation or an act or condition of removal, abstention, exclusion, release, subtraction, or differentiation
// protection from the sun
// relief from anxiety
- 3 —used as a function word to indicate the source, cause, agent, or basis
// we conclude from this
// a call from my lawyer
// inherited a love of music from his father
// worked hard from necessity

EXHIBIT D



absorb verb

Save Word

ab-sorb | \ əb-'sɔrb , -'zɔrb \

absorbed; absorbing; absorbs

Definition of *absorb*

transitive verb

- 1 **a** : to take in (something, such as water) in a natural or gradual way
// a sponge *absorbs* water
// charcoal *absorbs* gas
// plant roots *absorb* water
- b** : to take in (knowledge, attitudes, etc.) : ACQUIRE, LEARN
// ... convictions *absorbed* in youth ...
— M. R. Cohen
- c** : USE UP, CONSUME
// The fever *absorbed* her strength.
// His work *absorbs* all his time and attention.
- 2 : to take in and make part of an existent whole
// the capacity of a country to *absorb* new immigrants
- 3 : to engage or engross wholly
// an interest that *absorbs* her completely
// *absorbed* in thought
- 4 **a** (1) : to receive without recoil or echo
// provided with a sound-*absorbing* surface
(2) : ENDURE, SUSTAIN
// *absorbing* hardships
(3) : ASSUME, BEAR
// The expenses were *absorbed* by the company.
- b** : to transform (radiant energy) into a different form especially with a resulting rise in temperature
// The earth *absorbs* the sun's rays.

EXHIBIT E

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Plaintiff,)	
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v.)	C.A. No. 19-301 (RGA)
)	
NANOCELLECT BIOMEDICAL, INC.,)	
)	
Defendant.)	

PLAINTIFF’S LIST OF CLAIM TERMS THAT REQUIRE CONSTRUCTION

Pursuant to the Scheduling Order (D.I. 15), Plaintiff Cytonome/ST, LLC identifies the following claim terms of the asserted patents to be construed. Plaintiff reserves the right to amend or supplement this list, including in response to any claim terms or constructions proposed by Defendant or for any other reason, including based on information learned by Plaintiff as the case progresses beyond this early stage.

Claim Terms That Require Construction

A. U.S. Patent No. 6,877,528

1. “first reservoir” (Claims 1, 7, 9, and 17)
2. “a second reservoir for absorbing a pressure variation” (Claim 1)
3. “a second reservoir . . . for absorbing pressure variations” (Claim 9)
4. “a second reservoir for absorbing the pressure pulse” (Claim 17)
5. “a buffer . . . for absorbing the pressure pulse” (Claims 18 and 22)
6. “fluid” (Claims 1, 2, and 17)

B. U.S. Patent No. 8,623,295

1. “a first reservoir . . . adapted for dampening or absorbing a pressure pulse” (Claim 1)
2. “a second reservoir . . . adapted for generating the pressure pulse” (Claim 1)
3. “fluid” (Claims 5-8 and 11-15)

C. U.S. Patent No. 9,011,797

1. “dampening or absorbing the pressure pulse using [a/the] first reservoir” (Claims 1 and 18)
2. “a first reservoir . . . adapted for dampening or absorbing a pressure pulse” (Claim 5)
3. “a second reservoir . . . adapted for generating the pressure” (Claim 14)
4. “fluid” (Claims 1, 5, 8–11, and 18)

D. U.S. Patent No. 9,339,850

1. “a buffer . . . for absorbing or dampening the pressure pulse” (Claim 1)
2. “chamber” (Claims 3, 4, 10, 11)
3. “fluid” (Claims 9-11)

E. U.S. Patent No. 10,029,263

1. “the transient pressure pulse is not generated downstream of the switching region” (Claim 1)
2. “a reservoir adapted for dampening or absorbing the transient pressure pulse” (Claims 1 and 19)
3. “a reservoir . . . adapted for originating the transient pressure pulse” (Claims 5 and 20)
4. “a reservoir . . . to dampen or absorb a transient pressure pulse” (Claim 15)
5. “a reservoir . . . to originate the transient pressure pulse” (Claim 16)
6. “fluid” (Claims 7, 21)

F. U.S. Patent No. 10,029,283

7. “a first chamber” (Claim 1)
8. “a second chamber” (Claim 5)
9. “fluid” (Claims 1, 4, 5)

G. U.S. Patent No. 10,065,188

10. “a unique identifier” (Claim 11)

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EXHIBIT F



UNITED STATES PATENT AND TRADEMARK OFFICE

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NOTICE OF ALLOWANCE AND FEE(S) DUE

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EXAMINER

CHAMBERS, A MICHAEL

ART UNIT

PAPER NUMBER

3753

DATE MAILED: 11/22/2004

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/179,586	06/24/2002	John Richard Gilbert	TGZ-012	9722

TITLE OF INVENTION: MICROFLUIDIC SYSTEM INCLUDING A BUBBLE VALVE FOR REGULATING FLUID FLOW THROUGH A MICROCHANNEL

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1370	\$300	\$1670	02/22/2005

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. **PROSECUTION ON THE MERITS IS CLOSED.** THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. **THIS STATUTORY PERIOD CANNOT BE EXTENDED.** SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE REFLECTS A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE APPLIED IN THIS APPLICATION. THE PTOL-85B (OR AN EQUIVALENT) MUST BE RETURNED WITHIN THIS PERIOD EVEN IF NO FEE IS DUE OR THE APPLICATION WILL BE REGARDED AS ABANDONED.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL should be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). Even if the fee(s) have already been paid, Part B - Fee(s) Transmittal should be completed and returned. If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

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000959 7590 11/22/2004

LAHIVE & COCKFIELD, LLP.
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/179,586	06/24/2002	John Richard Gilbert	TGZ-012	9722

TITLE OF INVENTION: MICROFLUIDIC SYSTEM INCLUDING A BUBBLE VALVE FOR REGULATING FLUID FLOW THROUGH A MICROCHANNEL

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1370	\$300	\$1670	02/22/2005

EXAMINER	ART UNIT	CLASS-SUBCLASS
CHAMBERS, A MICHAEL	3753	137-827000

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5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/179,586	06/24/2002	John Richard Gilbert	TGZ-012	9722
000959	7590	11/22/2004	EXAMINER	
LAHIVE & COCKFIELD, LLP. 28 STATE STREET BOSTON, MA 02109			CHAMBERS, A MICHAEL	
			ART UNIT	PAPER NUMBER
			3753	
DATE MAILED: 11/22/2004				

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)

(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 0 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 0 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

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Notice of Allowability	Application No.		Applicant(s)	
	10/179,586		GILBERT ET AL.	
	Examiner		Art Unit	
	A. Michael Chambers		3753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS (IS OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to an amendment filed 09/22/04.
2. ☒ The allowed claim(s) is/are 1-16, 19 and 25-33.
3. ☒ The drawings filed on 24 June 2002 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.


Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

<ol style="list-style-type: none"> 1. <input type="checkbox"/> Notice of References Cited (PTO-892) 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) 3. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date <u>07/02/04</u> 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit of Biological Material 	<ol style="list-style-type: none"> 5. <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) 6. <input type="checkbox"/> Interview Summary (PTO-413), Paper No./Mail Date _____. 7. <input type="checkbox"/> Examiner's Amendment/Comment 8. <input type="checkbox"/> Examiner's Statement of Reasons for Allowance 9. <input type="checkbox"/> Other _____
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------


 A. Michael Chambers
 Primary Examiner
 Art Unit: 3753

09-24-04

3753

[Handwritten signature]



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Dated: September 22, 2004

Signature:

[Handwritten signature of Anthony A. Laurentano]
(Anthony A. Laurentano)

Docket No.: TGZ-012
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
John R. Gilbert, *et al.*

Application No.: 10/179586

Art Unit: 3753

Filed: June 24, 2002

Examiner: A.M. Chambers

For: MICROFLUIDIC SYSTEM INCLUDING A
BUBBLE VALVE FOR REGULATING FLUID
FLOW THROUGH A MICROCHANNEL

AMENDMENT IN RESPONSE TO NON-FINAL OFFICE ACTION

MS AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Dear Sir:

INTRODUCTORY COMMENTS

In response to the Office Action dated June 22, 2004 (Paper No. 20040622), please amend the above-identified U.S. patent application as follows:

Amendments to the Claims begin on page 2 of this paper.

Remarks/Arguments begin on page 7 of this paper.

CYTLLC_001289

Cytonome/ST, LLC Exhibit 2019

NanoCollect Biomedical, Inc. v. Cytonome/ST, LLC, IPR2020-00548

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AMENDMENT TRANSMITTAL LETTER				Docket No. TGZ-012	
Application No. 10/179,586-Conf. #9722		Filing Date June 24, 2002		Examiner A. M. Chambers	
				Art Unit 3753	
Applicant(s): John R. GILBERT <i>et al.</i>					
Invention: MICROFLUIDIC SYSTEM INCLUDING A BUBBLE VALVE FOR REGULATING FLUID FLOW THROUGH A MICROCHANNEL					
TO THE COMMISSIONER FOR PATENTS					
Transmitted herewith is an amendment in the above-identified application.					
The fee has been calculated and is transmitted as shown below.					
CLAIMS AS AMENDED					
	Claims Remaining After Amendment	Highest Number Previously Paid	Number Extra Claims Present	Rate	
Total Claims	26	- 26 =		x	0.00
Independent Claims	6	- 9 =		x	0.00
Multiple Dependent Claims (check if applicable) <input type="checkbox"/>					
Other fee (please specify):					
TOTAL ADDITIONAL FEE FOR THIS AMENDMENT:					0.00
<input type="checkbox"/> Large Entity <input checked="" type="checkbox"/> Small Entity					
<input checked="" type="checkbox"/> No additional fee is required for this amendment.					
<input type="checkbox"/> Please charge Deposit Account No. _____ in the amount of \$ _____. A duplicate copy of this sheet is enclosed.					
<input type="checkbox"/> A check in the amount of \$ _____ to cover the filing fee is enclosed.					
<input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.					
<input checked="" type="checkbox"/> The Director is hereby authorized to charge and credit Deposit Account No. <u>12-0080</u> as described below.					
<input checked="" type="checkbox"/> Credit any overpayment.					
<input checked="" type="checkbox"/> Charge any additional filing or application processing fees required under 37 CFR 1.16 and 1.17.					
 Anthony A. Laurentano Attorney Reg. No. 38,220				Dated: <u>September 22, 2004</u>	
LAHIVE & COCKFIELD, LLP 28 State Street Boston, Massachusetts 02109 (617) 227-7400					
I hereby certify that this correspondence is being deposited with the U.S. Postal Service as Express Mail, Airbill No. EV 419929425 US, in an envelope addressed to: MS Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the date shown below.					
Dated: September 22, 2004		Signature: (Anthony A. Laurentano)			

CYTLLC_001290

Cytonome/ST, LLC Exhibit 2019

NanoCollect Biomedical, Inc. v. Cytonome/ST, LLC, IPR2020-00548

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AMENDMENTS TO THE CLAIMS

Please amend claims 1 and 19 as set forth in the following listing of claims, which will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A microfluidic device, comprising:
 - a microchannel having an interior bounded by a side wall;
 - a valve for regulating the flow of fluid through the microchannel, the valve comprising a gas-filled first reservoir, a fluid meniscus interfacing the reservoir and the interior and an actuator for varying the volume of the first reservoir to increase an internal pressure of the first reservoir to vary the flow of ~~liquid~~ fluid through the ~~channel~~ microchannel; and
 - a second reservoir for absorbing a pressure variation in the microchannel induced by the actuator.
2. (Original) The microfluidic device of claim 1, wherein the actuator deflects the meniscus into the microchannel interior to regulate the flow of fluid through the microchannel.
3. (Original) The microfluidic device of claim 1, wherein the meniscus comprises a virtual wall formed in an aperture in the side wall of the microchannel when the microchannel is filled with a liquid.
4. (Original) The microfluidic device of claim 1, wherein the actuator generates a gas bubble in the microchannel.
5. (Original) The microfluidic device of claim 4, further comprising a hydrophobic patch attached to an inner wall of the microchannel for anchoring the gas bubble.
6. (Original) The microfluidic device of claim 4, wherein the microchannel defines a cavity for retaining the gas bubble.
7. (Previously Presented) The microfluidic device of claim 1, wherein the gas filled first reservoir comprises a movable membrane.

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8. (Original) The microfluidic device of claim 7, wherein the actuator deflects the movable membrane to create a bubble in the microchannel interior.

9. (Previously Presented) A microfluidic device comprising:

a first plate having a groove formed therein defining a microchannel;

a second plate for enclosing the microchannel bonded to the first plate having a first aperture formed on a first side of the groove sized and dimensioned to form a meniscus when the microchannel is filled with a liquid, the first aperture defining a first reservoir adjacent to the microchannel, wherein the meniscus forms an interface between the microchannel and the reservoir and a second reservoir formed on a second side of the groove opposite the first reservoir for absorbing pressure variations in the groove; and

a flexible membrane bonded to the second plate to seal the first reservoir.

10. (Original) The microfluidic device of claim 9, further comprising an actuator for deflecting the flexible membrane, wherein the deflection of the membrane increases the pressure in the reservoir and deflects the meniscus into the microchannel to regulate liquid flow therethrough.

11. (Original) The microfluidic device of claim 10, wherein the actuator comprises one of an electromagnetic element and a piezoelectric element.

12. (Original) The microfluidic device of claim 9, further comprising a hydrophobic patch attached to the groove.

13. (Original) The microfluidic device of claim 9, wherein the meniscus forms a bubble in the microchannel to block liquid flow.

14. (Original) The microfluidic device of claim 13, wherein the groove includes a cavity formed therein for retaining the bubble.

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15. (Previously Presented) A microfluidic device, comprising:
- a microchannel having an interior bounded by a side wall;
 - a first bubble valve for creating and injecting a bubble into the microchannel interior to regulate fluid flow through the microchannel;
 - a buffer in communication with the microchannel for absorbing a pressure variation in the microchannel caused by the bubble; and
 - a hydrophobic patch for retaining the bubble in a predetermined position in the microchannel interior.
16. (Original) The microfluidic device of claim 15, wherein the bubble valve comprises an aperture in the side wall, wherein a fluid in the microchannel forms a meniscus in the aperture, a sealed chamber formed adjacent to the aperture and an actuator for deflecting the meniscus into the interior by increasing the pressure in the chamber.
17. (Canceled).
18. (Canceled).
19. (Currently Amended) In a particle sorting device a bubble valve for separating particles having a predetermined characteristic from particles not having a predetermined characteristic, the bubble valve comprising:
- a first gas-filled reservoir;
 - a side channel in communication with a channel through which a stream of particles in a carrier fluid passes, wherein the carrier fluid forms a meniscus in the side channel adjacent to the gas-filled reservoir;
 - an actuator for deflecting the meniscus to create a pressure pulse to selectively deflect a particle having the predetermined characteristic from the stream of particles; and
 - a second reservoir for absorbing the pressure pulse.
20. (Canceled).
21. (Canceled).

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22. (Canceled).

23. (Canceled).

24. (Canceled).

25. (Previously Presented) A microfluidic device, comprising:
a channel for conveying a stream of particles in a carrier fluid;
an actuator for selectively applying a pressure pulse to the stream to deflect a particle in the stream of particles from the stream of particles; and
a buffer for absorbing the pressure pulse.

26. (Previously Presented) The device of claim 25, wherein the channel comprises an inlet, a first outlet and a second outlet, wherein the particles normally flow from the inlet into the first outlet.

27. (Previously Presented) The device of claim 26, wherein the pressure pulse deflects a particle in the stream of particles into the second outlet when a predetermined characteristic of the particle is detected.

28. (Previously Presented) The device of claim 25, further comprising a sensor for sensing a predetermined characteristic in a particle.

29. (Previously Presented) A microfluidic device, comprising:
a primary channel for conveying a stream of particles in a carrier fluid;
a first side channel in communication with the primary channel;
an actuator connected to the first side channel for applying a pressure pulse to the stream of particles to deflect a particle in the stream of particles from the stream of particles;
a second side channel in communication with the side channel; and
a buffer in communication with the second side channel for absorbing the pressure pulse.

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30. (Previously Presented) The microfluidic device of claim 29, wherein the actuator comprises a flexible membrane.
31. (Previously Presented) The microfluidic device of claim 29, wherein the buffer comprises a flexible membrane.
32. (Previously Presented) The microfluidic device of claim 29, wherein the actuator comprises air trapped in a sealed reservoir.
33. (Previously Presented) The microfluidic device of claim 29, wherein the buffer comprises air trapped in a sealed reservoir.

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REMARKS

The foregoing amendment amends claims 1 and 19. Pending in the application are claims 1-16, 19 and 25-33, of which claims 1, 9, 15, 19, 25 and 29 are independent. The following comments address all stated grounds for rejection and place the presently pending claims, as identified above, in condition for allowance.

Claim 1 is amended in line 6 change the word “liquid” to ---fluid--- and the word “channel” to ---microchannel--- to be consistent with other language in the claim.

Claim 19 amended in line 5 to delete the word “side” preceding “channel”. *No new matter is added.*

Amendment of the claims is not to be construed as an acquiescence to any of the objections/rejections set forth in the instant Office Action, and was done solely to clarify the claim language. Applicants reserve the right to pursue the claims as originally filed, or similar claims, in this or one or more subsequent patent applications.

35 U.S.C. 102 Rejections

Applicants thank the Examiner for the close review of the claims and for indicating that claims 9-16 are allowed and that claims 4-6 recite allowable subject matter. In the Office Action, the Examiner rejects claims 1-6, 19, 25-29, 32 and 33, under 35 U.S.C. 102(b) as being anticipated by Dunaway (U.S. Patent Number 3,289,687). Applicants respectfully traverse the rejection and submit that claims 1-6, 19, 25-29, 32 and 33 distinguish patentably over the Dunaway reference. The Dunaway reference does not teach or suggest increasing pressure within a reservoir to influence fluid flow in a microchannel interior, as recited in independent claim 1. The Dunaway reference also does not teach or suggest a reservoir for absorbing a pressure variation or a pressure pulse in a channel generated by an actuator, as recited in independent claim 1, 19, 25 and 29. The Dunaway reference further lacks a teaching or suggestion of an actuator for applying a pressure pulse to a stream of particles in a channel to

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deflect a particle in the stream of particles from the stream of particles, as set forth in independent claims 19, 25 and 29.

The Dunaway reference describes an actuator for a fluid amplifier that selectively redirects the flow path of an entire stream of fluid. The fluid amplifier of Dunaway includes a pair of exit ports 24 and 25 in communication with a chamber 27 through which a fluid stream flows. The fluid amplifier further includes a pair of offset orifices 28, 30 in communication with the chamber 27. Each orifice 28, 30 communicates with an aperture 32 or 34, respectively, that is selectively exposed or closed to atmosphere using an actuator. The actuator selectively opens one of the apertures 32 or 34 to create a differential pressure across the chamber 27, which acts across the fluid stream to force the path of the fluid stream towards one of the exit ports 24 or 26. When the actuator closes the first aperture 32 and opens the second aperture 34, the resulting pressure differential forces the fluid stream towards the first exit port 24. When the actuator opens the closes the second aperture 34 and opens the first aperture 32, the resulting pressure differential forces the fluid stream towards the second exit port 26. When both apertures are closed, the fluid stream is split between the two exit ports 24 or 26.

Claim 1 is allowable over the Dunaway reference for at least the following reasons. The chamber 27 of the Dunaway fluid amplifier is not a microchannel, as recited in claim 1. As set forth in the specification, a “microchannel” refers to a channel having cross-sectional dimensions in the range between about 1.0 μm and about 500 μm . Because the dimensions of the chamber 27 of Dunaway are very different from the dimensions of a microchannel, the fluid flowing through the chamber 27 of Dunaway will have vastly different properties. For example, fluid flow through the claimed microchannel will be laminar, while flow through the chamber 27 of Dunaway will not be laminar.

The Dunaway reference also does not teach or suggest *increasing* a pressure of a first gas-filled reservoir to control a flow through a microchannel, as recited in claim 1. Rather, Dunaway teaches selectively sealing one aperture to create a vacuum, i.e., to *decrease* the pressure therein, while maintaining the pressure in the other aperture at ambient pressure (exposed to atmosphere). Therefore, the Dunaway reference in fact teaches *away* from increasing a pressure of a gas-filled reservoir.

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Furthermore, the Dunaway reference lacks a teaching or suggestion of a second reservoir or buffer for absorbing a pressure variation in a microchannel induced by an actuator, as set forth in claim 1, or for absorbing a pressure pulse created by an actuator, as set forth in claims 19, 25 and 29. Applicants submit that the actuator of Dunaway does not create a pressure variation or pressure pulse, which are transient increases in pressure, but rather a pressure differential *condition* between two openings. However, even if the pressure differential could be considered a pressure pulse or variation, the pressure differential created by selectively opening one of the apertures in Dunaway is not absorbed by a reservoir or buffer, but rather transferred *to the stream of fluid* to change the flow path of the entire stream. Assuming, *arguendo*, that one of the apertures 32 or 34 *did* generate a pressure pulse or variation, were the other of the apertures 34 or 32 to absorb such a pressure pulse or variation, no pressure differential would be applied to the fluid stream. However, the Dunaway reference *requires* that the pressure differential be applied to the fluid stream, because otherwise, the fluid stream would not be capable of moving between the exit ports. In contrast, the claimed second reservoir *prevents* the pressure variation or pulse from influencing the overall flow of fluid through a channel. Because selectively redirecting the path of a flow stream to one of a plurality of exit ports is an objective of the Dunaway reference, the Dunaway reference therefore teaches *away* from a second reservoir capable of absorbing a pressure variation or pressure pulse.

In addition, Applicants respectfully submit that the Dunaway reference also fails to teach or suggest using a pressure pulse to deflect a particle in a stream of particles flowing through a channel *from* the stream of particles, as recited in claims 19, 25 and 29. Rather, as described above, the Dunaway reference only teaches changing the path of an *entire* stream of fluid between two outlets. The ability to apply a pressure pulse to a stream allows for separation of selected particles from the stream, while a buffer for absorbing the pressure pulse prevents application of the pressure pulse to other particles in the stream, thereby ensuring that only the selected particle is deflected. There is no teaching or suggestion in Dunaway that a selected particle can be separated from the stream of fluid flowing through the fluid amplifier.

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For at least these reasons, the Dunaway reference does not teach or suggest all of the features of claims 1-6, 19, 25-29, 32 and 33. As such, Applicants respectfully request that the rejection of these claims under 35 U.S.C. 102(b) be reconsidered and withdrawn.

35 U.S.C. 103 Rejections

Regarding the rejection of claims 7, 8, 19, 30 and 31 under 35 U.S.C. 103(a) as being unpatentable over the Dunaway reference in view of Cho, the claims are patentable over the Dunaway reference for the reasons described above.

In addition, there is no motivation to modify the device of Dunaway to include a “movable membrane.” In fact, the Dunaway reference teaches away from using a movable membrane, because the purpose of the actuator in Dunaway is to selectively expose the apertures 32 and 34 to atmosphere. Were the actuator to comprise a movable membrane, the apertures could not be exposed to atmosphere, and the device of Dunaway would fail to work.

For at least these reasons, pending claims 1-3, 16, 19 and 25-33 are patentable over the cited references. Because the Examiner has indicated claims 9-16 to be allowed, Applicants submit that all pending claims in the application are now in condition for allowance.

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CONCLUSION

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue. If, however, the Examiner considers that obstacles to allowance of these claims persist, we invite a telephone call to Applicant's representative.

Applicants believe no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 12-0080, under Order No. TGZ-012 from which the undersigned is authorized to draw.

Dated: September 22, 2004

Respectfully submitted,


By 
Anthony A. Laurentano
Registration No.: 38,220
LAHIVE & COCKFIELD, LLP
28 State Street
Boston, Massachusetts 02109
(617) 227-7400
(617) 742-4214 (Fax)
Attorney for Applicants

EXHIBIT G

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 14/689,508		Filing Date 04/17/2015		<input type="checkbox"/> To be Mailed					
ENTITY: <input checked="" type="checkbox"/> LARGE <input type="checkbox"/> SMALL <input type="checkbox"/> MICRO													
APPLICATION AS FILED – PART I													
(Column 1)		(Column 2)											
FOR	NUMBER FILED	NUMBER EXTRA			RATE (\$)	FEE (\$)							
<input type="checkbox"/> BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A			N/A								
<input type="checkbox"/> SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A			N/A								
<input type="checkbox"/> EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A			N/A								
TOTAL CLAIMS (37 CFR 1.16(j))	minus 20 = *				X \$ =								
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 = *				X \$ =								
<input type="checkbox"/> APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).												
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))													
* If the difference in column 1 is less than zero, enter "0" in column 2.					TOTAL								
APPLICATION AS AMENDED – PART II													
(Column 1)		(Column 2)		(Column 3)									
AMENDMENT	11/15/2017	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)					
	Total (37 CFR 1.16(i))	* 9	Minus	** 20	= 0	x \$80 =		0					
	Independent (37 CFR 1.16(h))	* 1	Minus	***3	= 0	x \$420 =		0					
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))												
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))												
						TOTAL ADD'L FEE		0					
(Column 1)		(Column 2)		(Column 3)									
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)					
	Total (37 CFR 1.16(i))	*	Minus	**	=	X \$ =							
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X \$ =							
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))												
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))												
						TOTAL ADD'L FEE							
<p>* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.</p> <p>** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".</p> <p>*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".</p> <p>The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.</p>										LIE ANNIE C. SINGLETON			

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

NANO_00009724

Cytonome/ST, LLC Exhibit 2019

NanoCollect Biomedical, Inc. v. Cytonome/ST, LLC, IPR2020-00548

Page 44 of 178



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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 Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/689,508	04/17/2015	John R. Gilbert	118153-01206	6290

106574	7590	10/16/2017
McCarter & English / Cytonome/ST, LLC		
265 Franklin St.		
Boston, MA 02110		

EXAMINER
GERIDO, DWAN A

ART UNIT	PAPER NUMBER
1797	

NOTIFICATION DATE	DELIVERY MODE
10/16/2017	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docket@mccarter.com

Case 1:19-cv-00301-RGA Document 14-689,508 Advisory Action Before the Filing of an Appeal Brief		Application No. 14/689,508 Filed 02/21/20 Page 46 of 178 Patent No. 10,117,818 Applicant: GILBERT ET AL.
Examiner Dwan A. Gerido	Art Unit 1797	AIA (First Inventor to File) Status No

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 18 September 2017 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.
NO NOTICE OF APPEAL FILED

1. ☒ The reply was filed after a final rejection. No Notice of Appeal has been filed. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114 if this is a utility or plant application. Note that RCEs are not permitted in design applications. The reply must be filed within one of the following time periods:

a) ☒ The period for reply expires 3 months from the mailing date of the final rejection.

b) ☐ The period for reply expires on: (1) the mailing date of this Advisory Action; or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.

c) ☐ A prior Advisory Action was mailed more than 3 months after the mailing date of the final rejection in response to a first after-final reply filed within 2 months of the mailing date of the final rejection. The current period for reply expires _____ months from the mailing date of the prior Advisory Action or SIX MONTHS from the mailing date of the final rejection, whichever is earlier.

Examiner Note: If box 1 is checked, check either box (a), (b) or (c). ONLY CHECK BOX (b) WHEN THIS ADVISORY ACTION IS THE FIRST RESPONSE TO APPLICANT'S FIRST AFTER-FINAL REPLY WHICH WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. ONLY CHECK BOX (c) IN THE LIMITED SITUATION SET FORTH UNDER BOX (c). See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) or (c) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☒ The proposed amendments filed after a final rejection, but prior to the date of filing a brief, will not be entered because:

a) ☒ They raise new issues that would require further consideration and/or search (see NOTE below);

b) ☐ They raise the issue of new matter (see NOTE below);

c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or

d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.

NOTE: See Continuation Sheet. (See 37 CFR 1.116 and 41.33(a)).

4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).

5. ☐ Applicant's reply has overcome the following rejection(s): _____.

6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).

7. ☒ For purposes of appeal, the proposed amendment(s): (a) ☒ will not be entered, or (b) ☐ will be entered, and an explanation of how the new or amended claims would be rejected is provided below or appended.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

9. ☐ The affidavit or other evidence filed after final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).

10. ☐ The affidavit or other evidence filed after the date of filing the Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing of good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).

11. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

12. ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because:
See Continuation Sheet.

13. ☐ Note the attached Information *Disclosure Statement(s)*. (PTO/SB/08) Paper No(s). _____

14. ☐ Other: _____

STATUS OF CLAIMS

15. The status of the claim(s) is (or will be) as follows:

Claim(s) allowed: _____

Claim(s) objected to: _____

Claim(s) rejected: 1-6 and 8-19.

Claim(s) withdrawn from consideration: _____

/Dwan A Gerido/ Examiner, Art Unit 1797	/Krishnan S Menon/ Primary Examiner, Art Unit 1777
--------------------------------------------	-------------------------------------------------------

Continuation of 3. NOTE: Applicant has introduced limitations that require further search and consideration. The Examiner is unable to complete the search within the time frame allowed under AFCP.

Continuation of 12. does NOT place the application in condition for allowance because: Applicant has attempted to introduce limitations from claim 7 into claim 1 to place the Application in condition for allowance. Canceled claim 7 was indicated as allowable in the Final Office Action dated May 18, 2017; however, Applicant has introduced limitations that are broader in scope compared to the subject matter that was indicated as allowable, thus the claims require further search and consideration. Applicant has also added new claims which were not considered in the previous Office Action.

NANO_00009727

Docket No. :18153-01206
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Ut il itAppl icat ionf:
John R. Gil bert et al .

Applicat ionNo. :14/689, 508

Confirmat ionNo. 6290

Fil edApril 17,2015

Art Unit: 1797

For: MI CROFLUID SYSTEMS INCLUDING A
BUBBLE VALVE FOR REGULATING FLUID
FLOW THROUGH A MICROCHANNEL

Examiner: D. A. Gerido

AMENDMENT AFTER FINAL ACTION UNDER 37 C. F. R. § 1. 116

MS AF
Commissioner for Pat ent s
P. OBox 1450
Alexandria, VA 22313-1450

Dear Sir:

INTRODUCTORY COMMENTS

In response to the Office Action dated May 18, 2017, the deadline for response to which is extended to September 18, 2017 by the accompanying request for a one-month extension of time, please amend the above-identified U. S. Patent application as follows:

Amendments to the Claims are reflected in the list of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 6 of this paper.

ME1 25613797v.1

Docket No.: 118153-01206
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Utility Application of:
John R. Gilbert et al.

Application No.: 14/689,508

Confirmation No.: 6290

Filed: April 17, 2015

Art Unit: 1797

For: MICROFLUIDIC SYSTEM INCLUDING A
BUBBLE VALVE FOR REGULATING FLUID
FLOW THROUGH A MICROCHANNEL

Examiner: D. A. Gerido

AMENDMENT AFTER FINAL ACTION UNDER 37 C.F.R. § 1.116

MS AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

INTRODUCTORY COMMENTS

In response to the Office Action dated May 18, 2017, the deadline for response to which is extended to September 18, 2017 by the accompanying request for a one-month extension of time, please amend the above-identified U.S. patent application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 6 of this paper.

ME1 25613797v.1

Application No. 14/689,508
Amendment dated September 18, 2017
After Final Office Action of May 18, 2017

Docket No.: 118153-01206

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A microfluidic device, comprising:
a microchannel having an interior bounded by a side wall, an inlet, a switching region, and a plurality of outlet channels downstream of the switching region, the microchannel formed in a microfluidic chip substrate and configured to accommodate a flow of liquid through the microchannel;

a valve operatively coupled to the switching region comprising a sealed reservoir, a side passage extending between the reservoir and the interior of the microchannel via an aperture in the side wall, the side passage configured to accommodate a volume of liquid between the interior of the microchannel and the reservoir[[]]; and

an actuator integrated in the microfluidic chip, the actuator configured to increase an internal pressure of the reservoir and move at least a portion of the volume of the liquid from the side passage into the microchannel to deflect a portion of the liquid flowing through the microchannel.
2. (Previously Presented) The microfluidic device of claim 1, wherein the actuator is configured to vary the volume of the reservoir.
3. (Previously Presented) The microfluidic device of claim 1, wherein actuation of the valve does not block the flow of liquid through the microchannel.
4. (Previously Presented) The microfluidic device of claim 1, wherein the actuator comprises one of a piezoelectric actuator and an electromagnetic actuator.
5. (Previously Presented) The microfluidic device of claim 1, wherein the sealed reservoir includes a movable wall, and
wherein the actuator deflects the movable wall to increase the internal pressure of the sealed reservoir.

Application No. 14/689,508
Amendment dated September 18, 2017
After Final Office Action of May 18, 2017

Docket No.: 118153-01206

6. (Previously Presented) The microfluidic device of claim 1, wherein the sealed reservoir includes a flexible membrane, and
wherein the actuator flexes the flexible membrane to increase the internal pressure of the sealed reservoir.
7. (Canceled)
8. (Currently Amended) The microfluidic device of claim [[7]] 1,
wherein increasing the internal pressure of the reservoir generates a pressure pulse within the switching region, and
wherein the pressure pulse travels across the flow direction of the liquid flowing through the microchannel.
9. (Previously Presented) The microfluidic device of claim 1, wherein a stream of particles in a carrier fluid flows through the microchannel, and
wherein, when the actuator increases the internal pressure of the reservoir, a pressure pulse selectively deflects a particle having a predetermined characteristic from the stream of particles.
10. (Currently Amended) The microfluidic device of claim [[1]] 8, further comprising a ~~buffer~~ second reservoir for absorbing the pressure pulse.
11. (New) A microfluidic device, comprising:
a microchannel having an interior bounded by a side wall, an inlet, a switching region, and a plurality of outlet channels downstream of the switching region, the microchannel formed in a microfluidic chip substrate and configured to accommodate a flow of liquid through the microchannel;
a valve operatively coupled to the switching region comprising a sealed reservoir, a side passage extending between the reservoir and the interior of the microchannel via an aperture in the

Application No. 14/689,508
Amendment dated September 18, 2017
After Final Office Action of May 18, 2017

Docket No.: 118153-01206

side wall, the side passage configured to accommodate a volume of liquid between the interior of the microchannel and the reservoir; and

an actuator operatively coupled with the microfluidic chip, the actuator configured to increase an internal pressure of the reservoir and move at least a portion of the volume of the liquid from the side passage into the microchannel to deflect a portion of the liquid flowing through the microchannel.

12. (New) The microfluidic device of claim 11, wherein the actuator is configured to vary the volume of the reservoir.

13. (New) The microfluidic device of claim 11, wherein actuation of the valve does not block the flow of liquid through the microchannel.

14. (New) The microfluidic device of claim 11, wherein the actuator comprises one of a piezoelectric actuator and an electromagnetic actuator.

15. (New) The microfluidic device of claim 11, wherein the sealed reservoir includes a movable wall, and

wherein the actuator deflects the movable wall to increase the internal pressure of the sealed reservoir.

16. (New) The microfluidic device of claim 11, wherein the sealed reservoir includes a flexible membrane, and

wherein the actuator flexes the flexible membrane to increase the internal pressure of the sealed reservoir.

17. (New) The microfluidic device of claim 11,

Application No. 14/689,508
Amendment dated September 18, 2017
After Final Office Action of May 18, 2017

Docket No.: 118153-01206

wherein increasing the internal pressure of the reservoir generates a pressure pulse within the switching region, and

wherein the pressure pulse travels across the flow direction of the liquid flowing through the microchannel.

18. (New) The microfluidic device of claim 11, wherein a stream of particles in a carrier fluid flows through the microchannel, and

wherein, when the actuator increases the internal pressure of the reservoir, a pressure pulse selectively deflects a particle having a predetermined characteristic from the stream of particles.

19. (New) The microfluidic device of claim 17, further comprising a second reservoir for absorbing the pressure pulse.

Application No. 14/689,508
Amendment dated September 18, 2017
After Final Office Action of May 18, 2017

Docket No.: 118153-01206

REMARKS

In this response, claims 1, 8, and 10 are amended and claim 7 is canceled. New claims 11-19 are added. Upon entry of this paper, claims 1-6 and 8-19 will be pending of which claims 1 and 11 are independent claims.

The amendment to claim 1 incorporates allowable subject matter from now-canceled claim 7. The amendment to claim 8 is made to correct antecedent basis in light of the amendment to claim 1. Support for the amendment to claim 10 may be found at page 17, lines 15-32 of the application as originally filed.

Support for new claim 11 may be found at least at page 6, lines 6-14, page 10, lines 6-29, page 12, lines 7-29, page 14, lines 1-9, page 16, line 29 to page 17, line 14, and page 17, lines 28-32 and in Figs 3, 4, 6, 16, and 17 of the application as originally filed.

Allowable Subject Matter

Applicant thanks the Examiner for indicating that claims 7 and 8 would be allowable if rewritten in independent form including all of the limitations of the base claim. In this response, Applicant has amended claim 1 to include subject matter from allowable claim 7.

Double Patenting

The Office Action rejects claims 1-10 as allegedly being unpatentable over claim 1 of U.S. Patent No. 6,877,528. Applicant submits herewith a Terminal Disclaimer averring to common ownership between the present application and the '528 Patent. Accordingly, Applicant requests reconsideration and withdrawal of this rejection of claims 1-6 and 8-10.

Claim Rejections Under 35 U.S.C. § 112

The Office Action rejects claim 10 for allegedly failing to comply with the written description requirement under 35 U.S.C. § 112. Specifically, the Office Action alleges that the term "buffer reservoir" is new matter. In this paper, Applicant amends claim 10 to recite "The microfluidic device of claim 8, further comprising a second reservoir for absorbing the pressure

Application No. 14/689,508
Amendment dated September 18, 2017
After Final Office Action of May 18, 2017

Docket No.: 118153-01206

pulse.” A second reservoir is described, for example, at page 17, lines 15-32 of the application as originally filed. Applicant submits that amended claim 10 does not include new matter and respectfully requests reconsideration and withdrawal of this rejection.

Claim Rejections under 35 U.S.C. § 103

The Office Action rejects claims 1-6 and 9 for allegedly being anticipated by U.S. Patent No. 6,033,191 to Kamper et al. In this response, Applicant amends claim 1 to include the subject matter indicated as allowable by the Examiner from now-canceled claim 7. As such, claim 1 and claims 2-6 and 9 that depend therefrom are patentable over Kamper for at least the reasons identified by the Examiner.

New Claims 11-19

New claims 11-19 are added in this response. Independent claim 11 is similar to independent claim 1 other than a recitation that the actuator is “operatively coupled with” the microfluidic chip. This recitation is supported, at least, at page 12, lines 7-29 of the originally filed application. Independent claim 11 includes the subject matter of now-canceled claim 7 that was indicated as allowable by the Examiner. Thus, claim 11 is patentable over Kamper. Claims 12-19 depend from claim 11 and add additional patentable recitations thereto. Applicant respectfully requests consideration and entry of new claims 11-19.

Application No. 14/689,508
Amendment dated September 18, 2017
After Final Office Action of May 18, 2017

Docket No.: 118153-01206

SUMMARY

In view of the above amendment, applicant believes the pending application is in condition for allowance.

For any fee asserted to be paid or that should have been paid with this filing, please charge our Deposit Account No. 50-4876, under Order No. 118153-01206 from which the undersigned is authorized to draw.

Dated: September 18, 2017

Respectfully submitted,

Electronic signature: /Nathan D. Harrison/
Nathan D. Harrison
Registration No.: 73,050
MCCARTER & ENGLISH, LLP
265 Franklin Street
Boston, Massachusetts 02110
(617) 449-6500
(617) 607-9200 (Fax)
Agent For Applicant

PTO/AIA/22 (03-13)

Approved for use through 7/31/2016. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)		Docket Number (Optional) 118153-01206																															
Application Number 14/689,508		Filed April 17, 2015																															
For MICROFLUIDIC SYSTEM INCLUDING A BUBBLE VALVE FOR REGULATING FLUID FLOW THROUGH A MICROCHANNEL																																	
Art Unit 1797		Examiner D. A. Gerido																															
<p>This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.</p> <p>The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"></th> <th style="text-align: center;"><u>Fee</u></th> <th style="text-align: center;"><u>Small Entity Fee</u></th> <th style="text-align: center;"><u>Micro Entity Fee</u></th> <th style="text-align: center;"></th> </tr> </thead> <tbody> <tr> <td><input checked="" type="checkbox"/> One month (37 CFR 1.17(a)(1))</td> <td style="text-align: center;">\$200</td> <td style="text-align: center;">\$100</td> <td style="text-align: center;">\$50</td> <td style="text-align: center;">\$ 200.00</td> </tr> <tr> <td><input type="checkbox"/> Two months (37 CFR 1.17(a)(2))</td> <td style="text-align: center;">\$600</td> <td style="text-align: center;">\$300</td> <td style="text-align: center;">\$150</td> <td style="text-align: center;">\$</td> </tr> <tr> <td><input type="checkbox"/> Three months (37 CFR 1.17(a)(3))</td> <td style="text-align: center;">\$1,400</td> <td style="text-align: center;">\$700</td> <td style="text-align: center;">\$350</td> <td style="text-align: center;">\$</td> </tr> <tr> <td><input type="checkbox"/> Four months (37 CFR 1.17(a)(4))</td> <td style="text-align: center;">\$2,200</td> <td style="text-align: center;">\$1,100</td> <td style="text-align: center;">\$550</td> <td style="text-align: center;">\$</td> </tr> <tr> <td><input type="checkbox"/> Five months (37 CFR 1.17(a)(5))</td> <td style="text-align: center;">\$3,000</td> <td style="text-align: center;">\$1,500</td> <td style="text-align: center;">\$750</td> <td style="text-align: center;">\$</td> </tr> </tbody> </table> <p><input type="checkbox"/> Applicant asserts small entity status. See 37 CFR 1.27.</p> <p><input type="checkbox"/> Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.</p> <p><input type="checkbox"/> A check in the amount of the fee is enclosed.</p> <p><input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.</p> <p><input checked="" type="checkbox"/> The Director has already been authorized to charge fees in this application to a Deposit Account.</p> <p><input checked="" type="checkbox"/> The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number <u>50-4876</u>.</p> <p><input checked="" type="checkbox"/> Payment made via EFS-Web.</p> <p>WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.</p> <p>I am the</p> <p><input type="checkbox"/> applicant.</p> <p><input checked="" type="checkbox"/> attorney or agent of record. Registration number <u>73,050</u>.</p> <p><input type="checkbox"/> attorney or agent acting under 37 CFR 1.34. Registration number _____.</p> <div style="display: flex; justify-content: space-between; margin-top: 20px;"> <div style="width: 45%;"> <p style="text-align: center;">_____ /Nathan D. Harrison/ Signature</p> <p style="text-align: center;">_____ Nathan D. Harrison Typed or printed name</p> </div> <div style="width: 45%;"> <p style="text-align: center;">_____ September 18, 2017 Date</p> <p style="text-align: center;">_____ (617) 449-6500 Telephone Number</p> </div> </div> <p>NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <input type="checkbox"/> * Total of <u>1</u> forms are submitted. </div>					<u>Fee</u>	<u>Small Entity Fee</u>	<u>Micro Entity Fee</u>		<input checked="" type="checkbox"/> One month (37 CFR 1.17(a)(1))	\$200	\$100	\$50	\$ 200.00	<input type="checkbox"/> Two months (37 CFR 1.17(a)(2))	\$600	\$300	\$150	\$	<input type="checkbox"/> Three months (37 CFR 1.17(a)(3))	\$1,400	\$700	\$350	\$	<input type="checkbox"/> Four months (37 CFR 1.17(a)(4))	\$2,200	\$1,100	\$550	\$	<input type="checkbox"/> Five months (37 CFR 1.17(a)(5))	\$3,000	\$1,500	\$750	\$
	<u>Fee</u>	<u>Small Entity Fee</u>	<u>Micro Entity Fee</u>																														
<input checked="" type="checkbox"/> One month (37 CFR 1.17(a)(1))	\$200	\$100	\$50	\$ 200.00																													
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<input type="checkbox"/> Four months (37 CFR 1.17(a)(4))	\$2,200	\$1,100	\$550	\$																													
<input type="checkbox"/> Five months (37 CFR 1.17(a)(5))	\$3,000	\$1,500	\$750	\$																													

ME1 25613798v.1

NANO_00009737

Cytonome/ST, LLC Exhibit 2019

NanoCollect Biomedical, Inc. v. Cytonome/ST, LLC, IPR2020-00548

Page 57 of 178

Doc Code: A.NE.AFCP

Document Description: After Final Consideration Pilot Program Request

PTO/SB/434 (05-13)

CERTIFICATION AND REQUEST FOR CONSIDERATION UNDER THE AFTER FINAL CONSIDERATION PILOT PROGRAM 2.0		
Practitioner Docket No.: 118153-01206	Application No.: 14/689,508	Filing Date: April 17, 2015
First Named Inventor: John R. Gilbert	Title: MICROFLUIDIC SYSTEM INCLUDING A BUBBLE VALVE FOR REGULATING FLUID FLOW THROUGH A MICROCHANNEL	
<p>APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS CONSIDERATION UNDER THE AFTER FINAL CONSIDERATION PILOT PROGRAM 2.0 (AFCP 2.0) OF THE ACCOMPANYING RESPONSE UNDER 37 CFR 1.116.</p> <ol style="list-style-type: none"> 1. The above-identified application is (i) an original utility, plant, or design nonprovisional application filed under 35 U.S.C. 111(a) [a continuing application (e.g., a continuation or divisional application) is filed under 35 U.S.C. 111(a) and is eligible under (i)], or (ii) an international application that has entered the national stage in compliance with 35 U.S.C. 371(c). 2. The above-identified application contains an outstanding final rejection. 3. Submitted herewith is a response under 37 CFR 1.116 to the outstanding final rejection. The response includes an amendment to at least one independent claim, and the amendment does not broaden the scope of the independent claim in any aspect. 4. This certification and request for consideration under AFCP 2.0 is the only AFCP 2.0 certification and request filed in response to the outstanding final rejection. 5. Applicant is willing and available to participate in any interview requested by the examiner concerning the present response. 6. This certification and request is being filed electronically using the Office's electronic filing system (EFS-Web). 7. Any fees that would be necessary consistent with current practice concerning responses after final rejection under 37 CFR 1.116, e.g., extension of time fees, are being concurrently filed herewith. [There is no additional fee required to request consideration under AFCP 2.0.] 8. By filing this certification and request, applicant acknowledges the following: <ul style="list-style-type: none"> • Reissue applications and reexamination proceedings are not eligible to participate in AFCP 2.0. • The examiner will verify that the AFCP 2.0 submission is compliant, i.e., that the requirements of the program have been met (see items 1 to 7 above). For compliant submissions: <ul style="list-style-type: none"> o The examiner will review the response under 37 CFR 1.116 to determine if additional search and/or consideration (i) is necessitated by the amendment and (ii) could be completed within the time allotted under AFCP 2.0. If additional search and/or consideration is required but cannot be completed within the allotted time, the examiner will process the submission consistent with current practice concerning responses after final rejection under 37 CFR 1.116, e.g., by mailing an advisory action. o If the examiner determines that the amendment does not necessitate additional search and/or consideration, or if the examiner determines that additional search and/or consideration is required and could be completed within the allotted time, then the examiner will consider whether the amendment places the application in condition for allowance (after completing the additional search and/or consideration, if required). If the examiner determines that the amendment does not place the application in condition for allowance, then the examiner will contact the applicant and request an interview. <ul style="list-style-type: none"> ▪ The interview will be conducted by the examiner, and if the examiner does not have negotiation authority, a primary examiner and/or supervisory patent examiner will also participate. ▪ If the applicant declines the interview, or if the interview cannot be scheduled within ten (10) calendar days from the date that the examiner first contacts the applicant, then the examiner will proceed consistent with current practice concerning responses after final rejection under 37 CFR 1.116. 		
Signature /Nathan D. Harrison/		Date September 18, 2017
Name (Print/Typed) Nathan D. Harrison		Practitioner Registration No. 73,050
<p>Note: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.</p>		
<input type="checkbox"/> * Total of <u>1</u> forms are submitted.		

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 14/689,508		Filing Date 04/17/2015		<input type="checkbox"/> To be Mailed		
ENTITY: <input checked="" type="checkbox"/> LARGE <input type="checkbox"/> SMALL <input type="checkbox"/> MICRO										
APPLICATION AS FILED – PART I										
(Column 1)		(Column 2)								
FOR	NUMBER FILED	NUMBER EXTRA			RATE (\$)	FEE (\$)				
<input type="checkbox"/> BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A			N/A					
<input type="checkbox"/> SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A			N/A					
<input type="checkbox"/> EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A			N/A					
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 = *				X \$	=				
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 = *				X \$	=				
<input type="checkbox"/> APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).									
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))										
* If the difference in column 1 is less than zero, enter "0" in column 2.					TOTAL					
APPLICATION AS AMENDED – PART II										
(Column 1)		(Column 2)		(Column 3)						
AMENDMENT	09/18/2017	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)			
	Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0	x \$80 =	0			
	Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	x \$420 =	0			
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))									
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
						TOTAL ADD'L FEE		0		
(Column 1)		(Column 2)		(Column 3)						
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)			
	Total (37 CFR 1.16(i))	*	Minus	**	=	X \$	=			
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X \$	=			
	<input type="checkbox"/> Application Size Fee (37 CFR 1.16(s))									
	<input type="checkbox"/> FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
						TOTAL ADD'L FEE				
<p>* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.</p> <p>** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".</p> <p>*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".</p> <p>The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.</p>										

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/689,508	04/17/2015	John R. Gilbert	118153-01206	6290
106574 7590 05/18/2017 McCarter & English / Cytonome/ST, LLC 265 Franklin St. Boston, MA 02110			EXAMINER GERIDO, DWAN A	
			ART UNIT 1797	PAPER NUMBER
			NOTIFICATION DATE 05/18/2017	DELIVERY MODE ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

doCKET@mccarter.com

Office Action SummaryApplication No.
14/689,508Applicant(s)
GILBERT ET AL.Examiner
Dwan A. GeridoArt Unit
1797AIA (First Inventor to File)
Status
No**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --****Period for Reply**A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 7/18/2016.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on ____.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on ____; the restriction requirement and election have been incorporated into this action.
- 4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

- 5) ☒ Claim(s) 1-10 is/are pending in the application.
5a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 6) ☐ Claim(s) ____ is/are allowed.
- 7) ☒ Claim(s) 1-6,9 and 10 is/are rejected.
- 8) ☒ Claim(s) 7 and 8 is/are objected to.
- 9) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

- 10) ☐ The specification is objected to by the Examiner.
- 11) ☒ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

- a) ☐ All b) ☐ Some** c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)
Paper No(s)/Mail Date 7-21-2016
- 3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____
- 4) ☐ Other: ____

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DETAILED ACTION

Double Patenting

1. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO internet Web site contains terminal disclaimer forms which may be used. Please visit <http://www.uspto.gov/forms/>. The filing date of the application will determine what form should be used. A web-based eTerminal Disclaimer may be filled out completely online

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using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to <http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp>.

2. Claims 1-10 are rejected on the ground of nonstatutory double patenting as being unpatentable over claim 1 of U.S. Patent No. 6,877,528. Although the claims at issue are not identical, they are not patentably distinct from each other because claim 1 of the instant application is sufficiently broad so as to encompass the limitations of claim 1 of U.S. Patent 6,877,528. Claim 1 of the instant application recites a microfluidic device comprising a microchannel, a valve comprising a gas-filled reservoir, a fluid meniscus, and an actuator. Claim 1 of the '528 Patent recites all the limitations of claim 1 of the instant application, and further recites a second reservoir. Based on the claim limitations, claim 1 of the instant application is broader in scope, and therefore encompasses the limitations of claim 1 of the '528 Patent.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

(a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claim 10 rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter

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which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 10 recites the microfluidic device comprising a buffer reservoir; however, after reviewing the specification, the Examiner contends that the specification does not provide a description for a buffer reservoir. In fact, the only instance in which the word "buffer" is recited is in the text of claim 10. Because the specification fails to recite a buffer reservoir, the Examiner deems claim 10 to be new matter, and not patentable under 35 U.S.C. first paragraph.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claim(s) s 1-6 and 9 is/are rejected under pre-AIA 35 U.S.C. 102(b) as being anticipated by Kamper et al., (US 6,033,191).

7. For claims 1-3, Kamper et al., teach a micromembrane pump comprising an inlet channel (microchannel, column 5 lines 2-3, figure 1 #'s 8 and 9) formed in the upper and lower housings (substrate, column 4 lines 61-65), a valve having a sealed reservoir (column 5 lines 8-13, figures 2 and 3 #14), a microchannel extending between the reservoir and the inlet channel (column 5 lines 21-26), and a piezoactuator integrated in the device (column 5 lines 30-41, figures 1-3 #5). The Examiner is reading the inlet channel of Kamper et al., as the claimed microchannel in that the inlet channel extends through the entire device so as to allow fluid flow. Furthermore, the

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Examiner notes that the phrase ‘configured to’ indicates the intended use of the claimed device. The device as taught by Kamper et al., is fully capable of performing the stated functions, thus the Examiner has not given the functional limitations patentable weight. Applicant is reminded that in claims directed to a device, patentability is governed by the structural features of the claimed device, and not its intended use. Additionally, claims 2 and 3 do not impart any structural features of the claimed actuator, as the claims only recite the intended use of the actuator.

8. For claim 4, Kamper et al., teach a piezoactuator (column 5 lines 30-41).
9. For claims 5 and 6, Kamper et al., teach the reservoir comprising a movable wall (column 5 lines 30-41, figures 2 and 3 #4). Kamper et al., also teach the movable wall as a flexible membrane (column 5 lines 30-41).
10. For claim 9, the Examiner notes that the claim does not recite any structural limitations of the claimed device, but instead recites the intended use of the device. The Examiner contends that the device if Kamper et al., is capable of performing in the manner recited in the claim.

Allowable Subject Matter

11. Claims 7 and 8 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.
12. The following is a statement of reasons for the indication of allowable subject matter: the prior art does not teach or suggest a microfluidic device wherein a microchannel includes a switching region wherein the claimed valve is located at the switching region.

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Response to Arguments

13. Applicant's arguments with respect to claims 1-10 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection. The Examiner notes that the claims have been examined under pre-AIA conditions, as the filing date is later than the filing date for Applications to be examined under AIA.

Conclusion

14. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dwan A. Gerido whose telephone number is (571)270-3714. The examiner can normally be reached on Monday - Friday, 9:00 - 6:30.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is

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encouraged to use the USPTO Automated Interview Request (AIR) at
<http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lyle Alexander can be reached on (571) 272-1254. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Dwan A Gerido/
Examiner, Art Unit 1797

/Krishnan S Menon/
Primary Examiner, Art Unit 1777

Notice of References Cited	Application/Control No. 14/689,508	Applicant(s)/Patent Under Reexamination GILBERT ET AL.	
	Examiner Dwan A. Gerido	Art Unit 1797	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-6,033,191 A	03-2000	Kamper; Klaus-Peter	F04B43/043	417/322
	B	US-				
	C	US-				
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

EXHIBIT H

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

CYTONOME/ST, LLC,)	
)	
Plaintiff,)	
)	
v.)	C.A. No. 19-301 (RGA)
)	
NANOCELLECT BIOMEDICAL, INC.,)	
)	
Defendant.)	

DECLARATION OF DR. GIACOMO VACCA

I, Giacomo Vacca, Ph.D., declare the following:

1. My name is Dr. Giacomo Vacca. I have been engaged by Cytonome/ST, LLC (“Cytonome”) as an independent expert consultant in this proceeding before the United States District Court for the District of Delaware. I have been asked by Cytonome’s attorneys to provide this declaration regarding Defendant NanoCollect Biomedical, Inc.’s (“NanoCollect”) Responsive Claim Construction Brief dated January 10, 2020. I have been asked to focus specifically on NanoCollect’s assertions of what a person of ordinary skill in the art would understand with respect to the meaning of the terms “reservoir,” “buffer,” “chamber,” “absorbing,” and/or “dampen” in certain asserted claims of U.S. Patent Nos. 6,877,528 (the “’528 Patent”); 8,623,295 (the “’295 Patent”); 9,011,797 (the “’797 Patent”); 9,339,850 (the “’850 Patent”); 10,029,263 (the “’263 Patent”); and 10,029,283 (the “’283 Patent”). My opinions and the bases for my opinions are set forth below.

I. Qualifications

2. Attached as Exhibit 1 is my curriculum vitae, incorporated by reference within this declaration. The following is a brief summary of my qualifications.

3. I received a Bachelor of Arts (B.A.) degree and a Master of Arts (M.A.) degree, both from Harvard University, in 1991, and a Doctorate (Ph.D.) in Applied Physics from Stanford University in 2001. As part of my doctoral dissertation work, I invented a technique to use light scattering to probe fluid phenomena on very short timescales, and designed and built a laboratory and all necessary custom equipment to demonstrate it. While pursuing my doctoral studies, I also worked as a Graduate Teaching Assistant, leading laboratory and discussion sessions and grading student assignments for physics courses.

4. From 1991 to 1994, I was Associate Physicist at Exxon Research & Engineering Company in Clinton, New Jersey. This facility was at the time the corporate research headquarters of Exxon Corporation. There I conducted X-ray scattering experiments to analyze and characterize complex fluids, thin films, and composite materials, and designed and built equipment to study the flow of multiphase fluids in porous media.

5. From 2000 to 2002, I was Design Physicist at Lightwave Microsystems Corp. in San Jose, California. I was a co-inventor of several issued patents at the intersection of optics and microfluidics, for applications from telecommunication to biotechnology. I set up a new laboratory for research and development of microfluidics-based optical devices, and prototyped early device concepts. I also designed optical integrated circuits (the equivalent of electronic integrated circuits, using light instead of electricity), modeled device behavior and analyzed fabrication data sets to improve yield and performance.

6. From 2002 to 2005, I took on the successive roles of Optical Engineer, Project Leader, and Product Marketing Manager at Picarro, Inc., in Sunnyvale, California, a company which at the time was developing and manufacturing solid-state lasers and laser-based instrumentation for applications in flow cytometry, microscopy, and spectroscopy. I was involved

in the development, transfer to manufacturing, and, later, marketing, of the Cyan laser product line—a compact and robust solid-state 488-nm laser light source aimed at the flow cytometry market. I also led the development of a tunable solid-state infrared laser for spectroscopy applications.

7. From 2005 to 2011, I was Program Development Manager in the New Product Introduction Department of the Hematology Business Unit, Diagnostics Division, of Abbott Laboratories in Santa Clara, California. I later took on additional, concurrent roles of Intellectual Property Manager in the same business unit; and I was a Member of the New Technology Group in the Diagnostics Division. I was responsible for generating, proving, developing, and ultimately launching new technology concepts in flow-cytometry-based semi-automated hematology analysis, encompassing all core aspects of reagent design, fluidic control, optical interrogation, signal processing, and cell identification algorithms. In 2010, in recognition of my research and innovation efforts, I was inducted as a Research Fellow into Abbott Laboratories' Volwiler Scientific Society—a scientific honor bestowed on less than 0.04% of the company's then worldwide employee base of more than 80,000. I also received several company awards for both research and research management.

8. Since 2011, I have been leading and growing the company I founded, Kinetic River Corp., a biophotonics design, consulting, and product development firm focused on flow cytometry and based in California's Silicon Valley. Through my company, I have been consulting for firms ranging from one-person startups to Fortune 500 multinationals; our client engagements cover a wide range of project types, from design and prototyping to intellectual property analysis, competitive landscaping, and technical due diligence in Mergers & Acquisitions (M&A). The focus of my company's efforts is the intersection of light and biology: flow cytometry is the core

competency, and most of our projects involve cell analysis. Since 2015, my consulting activities at Kinetic River have included a growing effort spent on expert witness cases.

9. In 2013, I co-founded BeamWise, Inc., a company developing software tools for the automation of optical system design, based in San Jose, California. I am Chief Scientific Officer at BeamWise, a role I carry out concurrently to my role as President of Kinetic River Corp.

10. I have published a number of papers in various areas of optics; most recently I have written flow-cytometry-related research and technical articles in peer-reviewed papers, conference proceedings, and professional publications. I am the inventor or co-inventor on 36 issued United States patents, 15 issued international patents, and 18 pending United States and international patent applications. I am the recipient of four competitive SBIR research incentive government grants from the National Institutes of Health. I have presented my original work regularly at flow cytometry and optics conferences and workshops, and I have been invited to chair sessions, deliver talks, lead workshops, and participate in panel discussions on topics from flow cytometry instrumentation to microfluidics to optical system design. A full list of my publications, patents and patent applications, conference presentations and invited talks is included in Exhibit 1.

II. Background

A. Materials Considered

11. I considered the following materials for this declaration, as well as any other materials cited herein:

- The Asserted Patents
- NanoCollect's Responsive Brief of January 10, 2020
- U.S. Patent No. 5,777,649
- U.S. Patent No. 6,592,821
- U.S. Patent No. 6,561,224
- U.S. Patent No. 5,976,336
- U.S. Patent No. 4,936,465

B. Compensation

12. I am being compensated at my standard consulting rate of \$600 per hour for the time I spend on this matter, I have no personal financial interest in any of the entities involved in this proceeding, and my compensation does not depend in any way on my testimony, my conclusions, or the outcome of my analysis.

C. Prior Testimony

13. I have provided expert testimony in the following matters:

- PGR2015-00017
- IPR2016-00756
- IPR2015-01870
- IPR2016-01418
- IPR2016-00927
- IPR2018-00248
- *Inguran, LLC v. ABS Global, Inc.*, No. 17-cv-446-WMC (W.D. Wis.)

III. Person of Ordinary Skill in the Art

14. I understand that my opinions should be from the perspective of a “person of ordinary skill in the art” at the time of the inventions. Accordingly, although I have not yet reviewed all of the relevant materials needed to fully assess and confirm the level of skill in the art, I have formed a preliminary opinion on the level of ordinary skill in the art, as described below, for the purposes of preparing this declaration.

15. I understand that the factors to be considered in determining the level of ordinary skill in the art are: (1) the educational level of active workers in the field, including the named inventors of the patent; (2) the type of problems encountered in the art; (3) prior art solutions to those problems; (4) the rapidity with which innovations are made; and (5) the sophistication of the technology in the art.

16. I understand that the ’528, ’295, ’797, ’850, ’263, and ’283 Patents (the “Asserted Patents”) claim priority to an application filed on April 17, 2002. Lacking any other information

at this time on the precise dates of the respective inventions claimed, I will use April 2002 as the operative date for determining the level of skill and knowledge of a person of ordinary skill in the art of these patents.

17. Based on my review of the three patents listed above, and my consideration of the abovementioned factors, it is my preliminary opinion that a person of ordinary skill in the art in April 2002 would be someone with a graduate degree in bioengineering or mechanical engineering, concentrating on fluid dynamics and having some hands-on experience with microfluidics; or with a bachelor's or master's degree in a related field and at least three years of experience in designing or developing microfluidic systems.

IV. Legal Standard for Indefiniteness

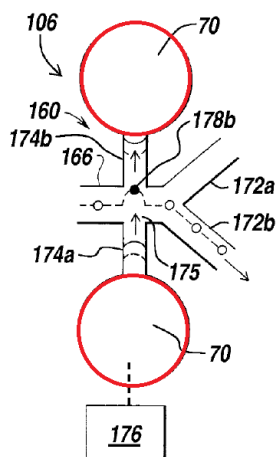
18. I understand that NanoCollect contends that some of the asserted claims are indefinite based on the indefiniteness of certain claim terms. I understand that a claim is not indefinite unless the claim, when read in light of the intrinsic record, fails to inform, with reasonable certainty, those skilled in the art about the scope of the invention. I have applied that standard where appropriate in this declaration.

V. “Reservoir”

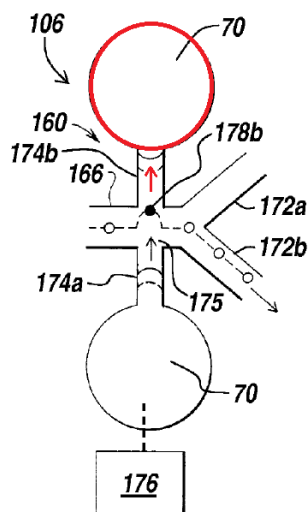
A. “Reservoir” in the '295 Patent (claim 1)

19. I understand from counsel for Cytonome that NanoCollect contends that claim 1 of the '295 Patent is indefinite because the patent “fails to disclose a sufficiently definite structure” for the term “reservoir.” I disagree for the reasons below.

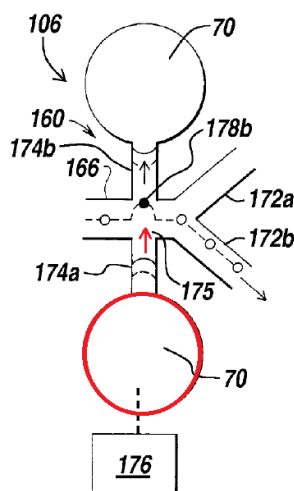
20. The term “reservoir” is used throughout the '295 Patent and refers to a specific structure. Figure 17A provides two examples of the claimed reservoirs (component 70, annotated in red):



21. The “reservoir” phrases in claim 1 of the ’295 Patent closely track this figure. Claim 1 recites “a first reservoir operatively associated with the flow channel and adapted for dampening or absorbing a pressure pulse propagated across the flow channel.” That is the top reservoir shown in Figure 17A, with the arrow indicating that the “first reservoir” receives the pressure pulse:



22. Claim 1 further recites “a second reservoir operatively associated with the flow channel and adapted for generating the pressure pulse based on a change in volume or pressure in the second reservoir.” That is the bottom reservoir in Figure 17A, with the arrow indicating that the “second reservoir” *generates* the pressure pulse:



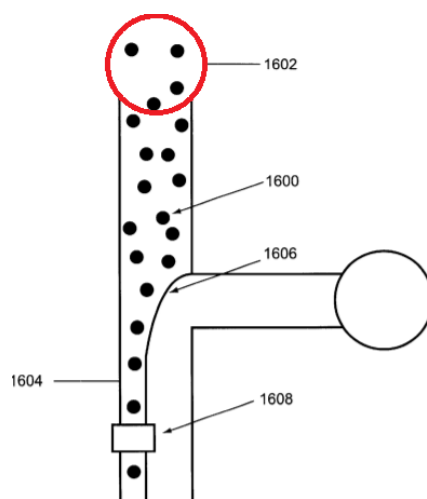
23. The '295 Patent's description of Figures 16–17C confirms this understanding. The patent describes two “bubble valves” that work in tandem to sort particles using the two reservoirs depicted in the figures. According to the specification, a detector “senses a predetermined characteristic in a particle,” which activates “actuator 176” (shown in Figure 17A above), which in turn “cause[s] pressure variations in the reservoir 70 of the first bubble valve.” See '528 Patent at 12:9–15, 23–37. This pressure variation deflects the selected particle having the predetermined characteristic—i.e., the “black” circle in Figure 17A above—into a different outlet from the other particles. *Id.* This corresponds to the “second reservoir operatively associated with the flow channel and adapted for generating the pressure pulse based on a change in volume or pressure in the second reservoir” in claim 1.

24. The specification further describes that the “second side passage 174b and the second bubble valve [106] absorb the transient pressure variations in the measurement duct 166 induced via the actuator 176” due to the resilient properties of “reservoir 70b.” *Id.* at 12:15–22. This corresponds to the “a first reservoir operatively associated with the flow channel and adapted for dampening or absorbing a pressure pulse propagated across the flow channel” in claim 1.

25. Accordingly, the specification would reasonably inform a person of skill at the time of the invention that the term “reservoir” in claim 1 of the ’295 Patent refers to a definite structure, namely a physical structure that contains fluid.

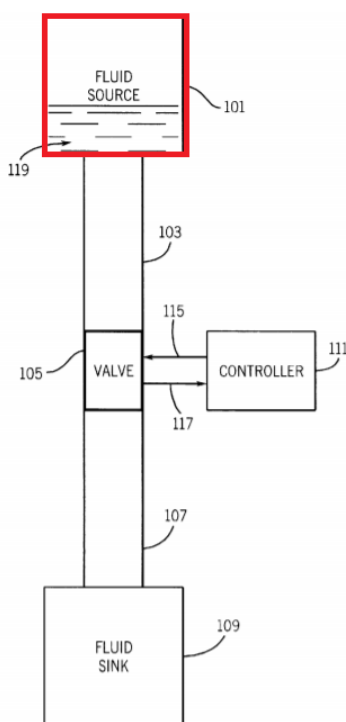
26. Furthermore, the term “reservoir” had a commonly understood meaning in the field of microfluidics in 2002 and was consistent with the reservoir structures described in the ’295 Patent. As explained in the Background of the Invention of the ’295 Patent, microfluidic systems or devices were understood at the time of the invention as “a network of processing nodes, *chambers and reservoirs* connected by channels, in which the channels have typical cross-sectional dimensions in the range between about 1.0 μm and about 500 μm .” *Id.* at 1:52–56 (emphasis added). The patentees therefore acknowledged that persons of skill would have already had an understanding of the term “reservoir,” or else they would not have understood how to include them in microfluidic systems or devices. I agree with this, and several references cited during prosecution of the Asserted Patents support this conclusion.

27. For example, Figure 16 of U.S. Patent No. 6,592,821 to Wada (“Wada”)—cited on the face of the ’295 Patent—depicts a “well” 1602:



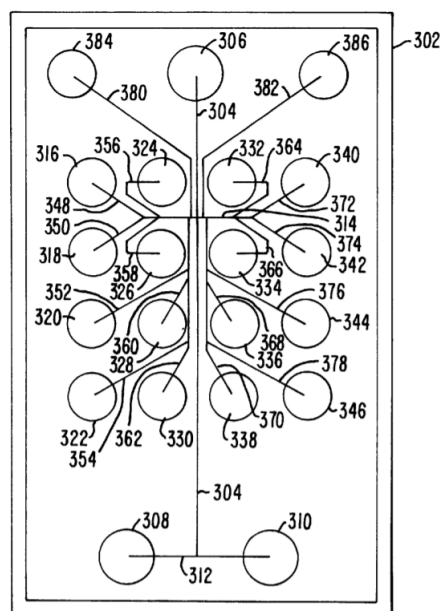
Wada at Fig. 16, 13:1–9. This is a typical example of a fluid reservoir formed as (often) a shallow cylindrical well in one or more layers of a substrate. Reservoirs are typically formed in this way in microfluidic devices due to ease of fabrication, but the exact geometry may vary.

28. U.S. Patent No. 6,561,224 to Cho (“Cho”)—which is cited on the face of the ’295 Patent—depicts another example of a reservoir as “fluid source” 101 in Figure 1:



Cho explicitly refers to this “fluid source” as a “reservoir[]” that can be employed in the micro-electro-mechanical systems (“MEMS”) disclosed in the Cho patent. Cho at 3:64-67. Such a structure would have been well-understood by persons of skill as another typical example of a “reservoir” at the time of the invention.

29. U.S. Patent No. 5,976,336 to Dubrow (“Dubrow”) provides additional examples. Dubrow is generally directed to “microfluidic devices which incorporate improved channel and reservoir geometries” and discloses several reservoirs formed in a substrate:



Dubrow at Fig. 3, 2:58–64; *id.*, 10:2–9; *id.*, 10:12–29.

30. Accordingly, a person of skill in the art would have been able to understand the scope of the term “reservoir” with reasonable certainty in light of the specification and the prior art cited therein. I therefore disagree with NanoCollect’s assertions that the “reservoir” phrases in the ’295 Patent are indefinite and that they “fail[] to disclose a sufficiently definite structure.”

B. “Reservoir” in the ’797 Patent (claims 1 and 18)

31. The term “reservoir” is also used in claims 1 and 18 of the ’797 Patent. Both the ’797 Patent and the ’295 Patent issued from continuation applications from a common parent application, and thus their specifications (text and Figures) are identical or nearly so, with only minor differences in the claims. *See, e.g.*, ’797 Patent, Fig. 17A, 12:23–47. “Reservoir” is used in the same manner in both patents’ claims. For those reasons, a person of skill would have understood the term “reservoir” to have the same meaning as in the ’295 Patent. For example, claim 1 recites “dampening or absorbing the pressure pulse using a first reservoir in fluid

communication with the microfluidic flow channel,” which is very similar to the language employed for the first reservoir in the ’295 Patent claims.

32. Accordingly, the claims and phrases that use the term “reservoir” in the ’797 Patent are not indefinite for the same reasons described for the ’295 Patent.

C. “Reservoir” in the ’263 Patent (claims 1, 5, 15, and 16)

33. The term “reservoir” is also used in claims 1, 5, 15, and 16 of the ’263 Patent. The ’263 Patent shares a common ultimate parent application with the ’295 and ’797 Patents, and the named inventors are the same. Much of the text and Figures of the ’263 Patent are common to the ’295 and ’797 Patents. Figure 2 of the ’263 Patent, for example, is identical to Figure 17A of the ’295 and ’797 Patents (illustrated in annotated form above), save for element renumbering. And while there are minor differences in the claims, the term “reservoir” is used in the same sense in all claims. For example, claim 5 recites “a reservoir operatively associated with the switching device and adapted for originating the transient pressure pulse,” which is very similar to the language employed for the second reservoir in the ’295 Patent claims.

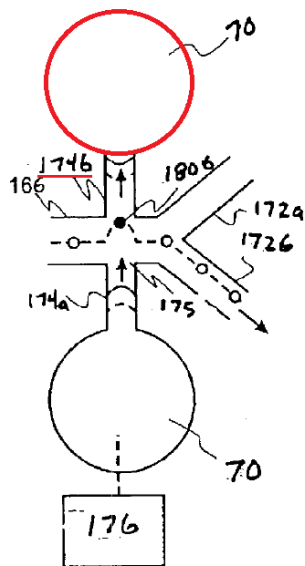
34. In summary, after reviewing the claims and specification of the ’263 Patent, I found that a person of skill would have understood the term “reservoir” to have the same meaning as in the ’295 and ’797 Patents. Accordingly, the claims and phrases that use the term “reservoir” in the ’263 Patent are not indefinite for the same reasons described for the ’295 and ’797 Patents.

VI. “Buffer”

A. “Buffer” in the ’528 Patent (claims 18, 22, and 24)

35. The context of the claims in light of the specification makes clear that the term “buffer” in the ’528 Patent claims refers to a physical structure that contains fluid and receives a pressure pulse. Claims 18 and 22 both refer to a “buffer” as a structure “for absorbing the pressure pulse” (and claim 24 includes a “buffer” through its dependency on claim 22). Claim 22 further

specifies that the “buffer” is “in communication with the second side channel.” A person of skill would understand the top “reservoir” in Figure 17A as an example of the claimed buffer (component 70, annotated in red) because it receives the pressure pulse to be absorbed (as indicated by the arrow) and is connected to a “side channel” 174b:

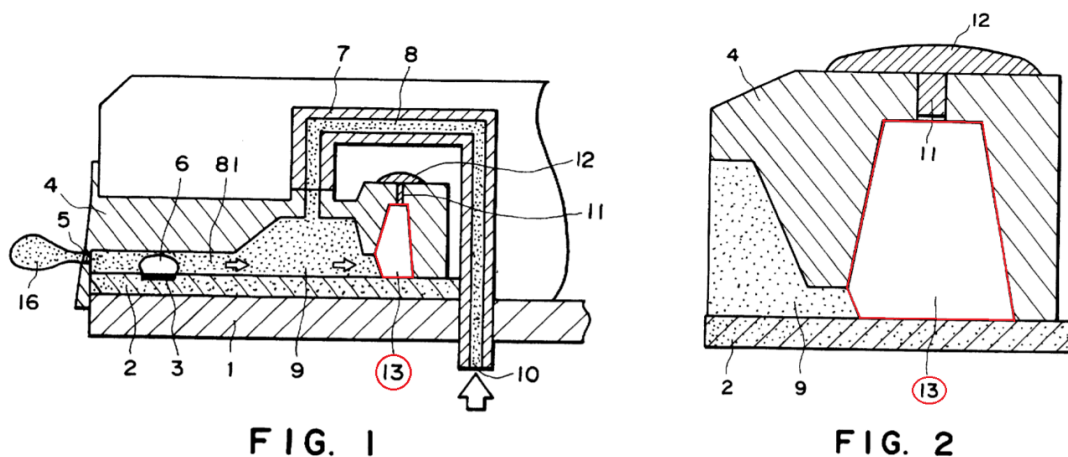


36. The '528 Patent's description of Figures 16–17C confirms this understanding. The patent describes two “bubble valves” that work in tandem to sort particles using the reservoir/buffer depicted in the figures. According to the specification, the “second side passage 174b and the second bubble valve [106] absorb the transient pressure variations in the measurement duct 166 induced via the actuator 176” due to the resilient properties of “reservoir 70b.” *Id.* at 12:27–34. In other words, the “buffer” is the same as the “first reservoir” claimed in the '295 Patent above. A person of skill would understand that the reservoir that receives the pressure pulse in the '528 Patent is an example of a “buffer.”

37. I understand from counsel for Cytonome that NanoCollect contends that claims 18, 22, and 24 of the '528 Patent are indefinite because “the term is not used, let alone defined, anywhere in the specification of the '528 patent” and thus “the POSA would not understand its

metes and bounds.” For the reasons above, the specification provides sufficient guidance to inform a person of skill with reasonably certainty the “metes and bounds” of the term “buffer.”

38. Furthermore, the term “buffer” had a commonly understood meaning in the field of microfluidics in 2002 consistent with the above understanding. For example, U.S. Patent No. 5,777,649 to Otsuka (“Otsuka”)—cited on the face of the ’528 Patent—is generally directed to an “ink jet printing head” and refers to a “buffer chamber” or “buffering chamber” that is a chamber structure used “for retaining air to absorb vibration of the ink” depicted as component 13 in Figures 1 and 2:



Otsuka at 6:24–39, Figs. 1 and 2 (annotated). A person of skill would have understood these openings—when configured to receive vibrations or pressure variations—as a typical example of a “buffer.”

39. Additionally, the term “buffer” has a plain an ordinary meaning, i.e., “something that absorbs or mitigates variations,” which underlies its use in a variety of contexts. For example, in chemistry, “buffer” is generally used to mean “a solution that mitigates pH variations.” In electronics, a “buffer” can be used to mean “a component that prevents variations in load impedance to affect upstream portions of a circuit.” And in mechanical engineering, a “buffer” is

commonly used to mean a “structure that absorbs vibrations.” The usage of “buffer” in the context of the Asserted Patents is just another example of this plain and ordinary meaning of the word.

40. I understand from counsel for Cytonome that NanoCollect contends that the term “buffer” is indefinite because “[t]here is no commonly understood structure associated with the term ‘buffer,’ it does not have a plain and ordinary meaning as used, and was not commonly used in the field of microfluidics to describe components that receive pressure pulses at the time of the invention.” As shown by usage in a variety of fields, “buffer” does have a plain and ordinary meaning as used; and as shown by the prior art, the term “buffer” had a well-understood meaning in the field, and persons of skill understood “buffers” to refer to components that receive pressure pulses at the time of the invention.

41. For all of these reasons, I disagree with NanoCollect’s assertion that the “buffer” phrases in the ’528 Patent are indefinite. A person of skill in the art would have been able to understand the scope of the term “buffer” with reasonable certainty in light of the specification and the prior art cited therein.

B. “Buffer” in the ’850 Patent (claims 1 and 11)

42. The term “buffer” is also used in claims 1 and 11 of the ’850 Patent. The ’850 Patent issued from a continuation-in-part of a parent application of the ’528 Patent, and thus their specifications (text and Figures) and claims are very similar. “Buffer” is used in the same manner in both patents’ claims. For those reasons, a person of skill would have understood the term “buffer” to have the same meaning as in the ’528 Patent. For example, claim 1 of the ’850 Patent recites “a buffer configured to fluidically co-operate with the actuator for absorbing or dampening the pressure pulse,” which is very similar to the language employed for the buffer in the ’528 Patent claims. Furthermore, the ’850 Patent uses many of the same figures as the ’528 Patent, as well as nearly identical descriptions of those figures. *See, e.g.*, ’850 Patent, Figs. 2–4, 8:22–9:7.

Accordingly, the claims and phrases that use the term “buffer” in the ’850 Patent are not indefinite for the same reasons described for the ’295 Patent.

43. Moreover, the ’850 Patent provides additional, specific examples of “buffers.” For example, the specification explains that “[t]he second bubble valve 100a serves as a buffer for absorbing the pressure pulse created by the first bubble valve 100b.” *Id.* at 6:24–26. It also describes a “second side passage 24a, positioned opposite of the first side passage 24b is hydraulically connected to a buffer chamber 70a in the second bubble valve 100a for absorbing pressure transients.” *Id.* at 6:31–35; *see also* 7:31–33. All of these examples would confirm to a person of skill that a buffer has a definite structure in the Asserted Patents, namely a physical structure for receiving a pressure pulse.

VII. “Chamber”

A. “Chamber” in the ’283 Patent

44. The term “chamber” is used in claims 1, 5, and 6 of the ’283 Patent. Based on my review of the claims and specification, I conclude that a person of skill would have understood the term “chamber” to have the same meaning as “reservoir,” namely a physical structure that contains fluid.

45. For example, claim 1 of the ’283 Patent recites a “first chamber in fluid communication with the duct via a first side opening” and “an actuator provided on the substrate and associated with the first chamber, the actuator configured to increase a pressure within the first chamber and to discharge an amount of fluid from the first side opening into the duct.” This language closely tracks the “reservoir” phrases recited above for the ’295, ’797, and ’263 Patents. For instance, claim 1 of the ’295 recites a “second reservoir operatively associated with the flow channel and adapted for generating the pressure pulse based on a change in volume or pressure in the second reservoir, and dependent claim 2 further specifies “an actuator or pressurizer

operatively associated with the second reservoir and adapted for generating the pressure pulse by varying the volume or pressure in the second reservoir.”

46. In other words, “chamber” in the ’283 Patent and “reservoir” in the ’295 Patent both describe a component, connected to a “duct” (a.k.a., a “flow channel”), in which component pressure is varied by an actuator to generate a pressure pulse. In fact, the ’295 Patent specification explicitly uses the term “chamber” to describe a “reservoir.” *See, e.g.*, ’295 Patent at 12:18–20 (“Basically, the reservoir 70b of the second bubble valve 10b is a chamber . . .”). And the ’283 Patent uses the term “chamber” to describe the “buffer” and “actuator” reservoirs (70a and 70b) shown in the figures that are common to all Asserted Patents. *See, e.g.*, ’283 Patent at 9:30–34 (“More particularly, the actuator chamber 70b and the buffer chamber 70a may be placed such that the flow resistance between them is less than the flow resistance between a selected particle and a subsequent particle in the stream of particles.”); Figs. 1–4.

47. Accordingly, a person of skill would have understood the term “chamber” in the ’850 Patent claims to have the same meaning as “reservoir” in the ’295, ’797, and ’263 Patents.

B. “Chamber” in the ’850 Patent

48. The term “chamber” is also used in claims 10 and 11 of the ’850 Patent. Both the ’850 Patent and the ’283 Patent issued from continuation applications from a common parent application, and thus their specifications (text and Figures) are identical or nearly so, with only minor differences in the claims. *See, e.g.*, ’850 Patent, Figs. 1–4, 8:22–48. “Chamber” is used in the same manner in both patents’ claims. For those reasons, a person of skill would have understood the term “chamber” to have the same meaning as in the ’283 Patent. For example, the ’850 Patent uses the same language as the ’283 Patent to describe the “buffer chamber 70a” and the “compression” or “actuator chamber 70b” in the figures. ’850 Patent at Figs. 1–4, 6:27–40, 7:31–33, 9:18–22.

49. Accordingly, a person of skill would have understood the term “chamber” in the ’850 Patent claims to have the same meaning as “reservoir” in the ’295, ’797, and ’263 Patents.

VIII. “Absorbing”

50. The term “absorbing” (and variants, such as “absorbs”) is used in the ’528 Patent, claims 18 and 22; ’295 Patent, claims 1 and 9; ’797 Patents, claims 1 and 18; ’850 Patent, claim 1; and ’263 Patent, claims 1 and 15. After reviewing the claims and specifications, I disagree with NanoCollect’s contention that “absorbing” means “to receive without recoil or echo.” Notably, I do agree with NanoCollect’s construction to the extent that the reservoirs/chambers/buffers used for “absorbing” must “receive” the pressure pulse/wave/variation. That is because the term “absorbing” has a well understood meaning, which is simply to “take up” or “take in.” And I also generally agree that “a POSA would understand that absorption of a pressure pulse prevents disturbance to the flow of the non-selected particles in the stream of particles.” The specification supports that. *See, e.g.*, ’850 Patent at 9:48–56. But that language does not prohibit all recoil or echo of the pressure wave in the device.

51. A person of skill would not understand the term “absorbing” to preclude any and all rebound or echo. This is because, as a practical matter, microfluidic devices cannot be manufactured to be perfectly, or ideally, resilient such that absolutely no echo occurs when a pressure pulse is taken into a buffer or the like. In terms of a “buffer” or “reservoir” for absorbing a pressure pulse, some rebound or echo will almost always exist due to common design constraints (such as the size of the buffer, a common constraint in microfluidics; and the properties of the materials used in manufacturing as well as in operation of the device). A person of skill would readily understand this.

52. At the same time, a person of skill would understand that “absorption” is nonetheless required, and therefore will design the buffer with the proper resiliency for achieving

the absorption needed for the application at hand. Two examples for providing such resiliency are to use a “flexible membrane” in a liquid-filled reservoir or to partially fill the reservoir with a compressible gas instead of a liquid (or with a more compressible liquid). *See, e.g.*, ’263 Patent at 9:26–29; ’528 Patent at 11:8–14; ’850 Patent at 9:51–56. This resiliency may be controlled so as to reduce echo/rebound, for example, by choosing membranes of appropriate flexibility or choosing a gas (or liquid) of appropriate compressibility.

53. The ’850 Patent describes this “resiliency” as a “spring constant,” which is a common and well-known physical characteristic that indicates the “stiffness” of a device and (more specifically in this context) would indicate the “absorption” capacity of the buffer. The ’850 Patent explains that “[t]he spring constant of the buffer 100b *may be varied according to the particular requirements* by varying the volume of the buffer chamber 70b, the cross-sectional area of the side passage 24b and/or the stiffness or the thickness of a flexible membrane (reference 72 in FIG. 7) forming the buffer chamber 70b.” ’850 Patent at 9:51–56 (emphasis added). In other words, the patentees contemplated different levels of “absorption” for different applications. Persons of skill would understand that the characteristics for varying the spring constant (such as the volume of the buffer) are to be selected by the designer, who will be familiar with the tolerable amount of echo/rebound for his or her particular application.

54. In sum, depending on whether his or her “particular requirements” necessitate absorbing more or less of the pressure wave, a person of skill could configure the buffer to meet that need. And although this particular statement regarding the “spring constant” of the buffer does not appear in the other patents at issue here, the concepts of buffer design—including “spring constant”—were well known to a person of skill.

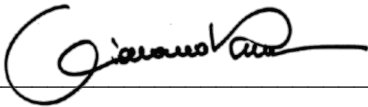
55. To use an analogy, this concept is somewhat similar the shock absorber on a car. The road shock is taken up, but some of that shock is inevitably returned when the shock absorber rebounds. How much or little rebound depends on selected design criteria of the shock absorber (such as pressure, volume, etc.), which need only ensure that the objectives for that particular car are achieved. Likewise, in the Asserted Patents, the echo or rebound of some of the pressure pulse/wave is tolerable so long as it doesn't defeat the sorting operation, i.e., knock the non-selected particles out of their intended flow path for sorting, as stated in the '850 Patent at 9:48–51.

IX. “Dampen”

56. The term “dampen” (and variants, such as “dampening”) is used in many asserted claims, including '295 Patent, claims 1, 9; '797 Patent, claims 1 and 18; '850 Patent, claim 1; '263 Patent, claims 1 and 15. After reviewing the claims and specifications, I do not find unreasonable NanoCollect's proposal to construe “dampen” as “to meaningfully dissipate.”

57. I do not agree, however, with some of NanoCollect's statements in its Responsive Brief regarding the application of this construction. In particular, I disagree that “upon being meaningfully dissipated, a pressure pulse would not reflect off of the absorbent.” Similar to its incorrect interpretation of “absorbing,” this would require eliminating *any* “recoil or echo.” The Asserted Patents do not require this degree of “dampening” for the same reasons it does not require this degree of “absorption.” The Asserted Patents only require that dampening, like absorption, be such so as to “prevent[] a pressure wave ... from ... affecting the flow of the remaining particles in the stream of particles.” *See, e.g.,* '263, 11:20–25.

I declare, under penalty of perjury, under the laws of the United States, that the foregoing is true and correct and that this Declaration was completed this 31st day of January, 2020.

A handwritten signature in black ink, appearing to read 'Giacomo Vacca', is written over a horizontal line.

Giacomo Vacca, Ph.D.

Exhibit 1

GIACOMO VACCA, Ph.D.

GVacca@KineticRiver.com

www.KineticRiver.com

www.linkedin.com/in/gvacca

CAREER HIGHLIGHTS

- 84 patents filed, 52 issued, 18 pending
- 4 competitive SBIR grant awards from the National Institutes of Health, including a Phase II
- 23 years experience in research and product development
- 20 years experience in intellectual property generation, landscape analysis, and management
- 6 years experience leading hematology R&D group
- Managed 15 people, multimillion-dollar development programs, and IP portfolios
- Volwiler Research Fellow at Abbott Laboratories
- Associate Editor, *Cytometry Part A*
- Stanford Ph.D.
- Harvard B.A., M.A.

KEY INTELLECTUAL PROPERTY EXPERIENCE

- 18 years experience in flow cytometry and sorting
- 30 years experience in optics and lasers
- 75 patents filed in flow cytometry and sorting
- 5 years experience managing IP portfolio for business unit of Fortune 100 company
- 15 years experience performing technical IP evaluations, due diligence, technology assessment
- Participated in Silicon Valley Business Leader Briefing on IP and Patent Reform with USPTO Director, Michelle Lee
- Expert witness on patent infringement, trade secrets, IPR and PGR proceedings
- Expert witness testimony: 11 cases, 12 reports, 5 depositions
- Trial experience: district court trial (Madison, WI, Sept. 2019); provided 3 testimonies (infringement, validity, damages)

KEY TECHNICAL KNOW-HOW

- Flow cytometry, hematology, *in vitro* diagnostics, fluorescence-activated cell sorting
- Fluorescence assays, next-gen immunoassays, next-gen DNA sequencing
- Fluorescence detection systems, biosensors, optofluidics, microfluidics, microoptics, optical waveguides
- Nonlinear optics, nonlinear spectroscopy, confocal microscopy, optical microscopy
- Laser design, laser architectures, optical system design
- Pulsed ultrafast lasers, frequency conversion
- Light scattering, X-ray scattering, light-matter interaction
- Digital electronics, analog electronics, ultrafast circuitry

EXPERIENCE

Founder and President

2010 to present

Kinetic River Corp., Mountain View, CA

- Established biophotonics design and engineering consulting company
- Designed, developed and launched the *Potomac* modular flow cytometer; sold one unit and two upgrades to National Cancer Institute
- Designed, developed and launched the *Danube* fluorescence lifetime flow cytometer; sold one unit, one upgrade, and one optical engine to New Mexico State University

- Awarded one \$1.5M Phase II SBIR grant from National Institute of General Medical Sciences
- Awarded three Phase I SBIR grants from National Institute of General Medical Sciences
- Designed and built a working 2-laser, 6-detector flow cytometer prototype in less than 2 months
- Performed due-diligence technology assessment for leading OEM on international M&A project
- Executed and delivered designs, prototypes, design reviews, technology evaluations, IP assessments, and market studies
- Developed and delivered training seminars on flow cytometry and other biophotonics technologies and markets

Co-founder and Chief Science Officer

2013 to present

BeamWise, Inc., San Jose, CA

- Established optomechanical design automation company
- Introduced BeamWise software tool and services to bridge gap between optomechanical design and implementation

Volwiler Research Fellow

2010 to 2011

Abbott Laboratories, Abbott Park, IL

- Organized and hosted IP harvesting workshop leading to 130 new disclosures in strategic flow cytometry areas
- Successfully completed multi-year research & feasibility program for breakthrough hematology platform

Intellectual Property Manager

2007 to 2011

Abbott Hematology, Santa Clara, CA

- Hematology business unit representative on Diagnostics Division-wide Patent Governance Board
- Responsible for managing hematology IP portfolio (disclosures, patent applications, nationalization, and abandonment)
- Held IP training session, implemented IP tracking metrics, and substantially increased site disclosures and applications

Member, New Technology Group

2006 to 2011

Abbott Diagnostics, Abbott Park, IL

- Carried out technology assessment on dozens of companies for prospective partnering/licensing/acquisition transactions
- Performed due diligence, developed deal structure, and coauthored offer resulting in acquisition of IP assets

Program Manager, R&D

2005 to 2011

Abbott Hematology, Santa Clara, CA

- Responsible for early-stage R&D and feasibility of next-generation hematology reagents, assays, and analyzers
- Managed group of 15 engineers and scientists and a multimillion-dollar budget for R&D and product support projects
- Invented novel technology for cellular analysis and led project through feasibility with working prototypes
- Launched new hematology analyzer and delivered six major upgrades through feasibility, integration, and testing
- Supported two 510(k) class-II medical device submissions to the FDA with data analysis and feasibility reports
- Developed interactive simulation platforms to model flow cytometer operation
- Coordinated response to field actions on CELL-DYN products, from root cause investigation to issue resolution
- Created and championed adoption of resource tracking tools for project planning and execution

Product Marketing Manager, Cyan Laser Product Line

2004 to 2005

Picarro, Inc., Sunnyvale, CA

- Responsible for company's largest revenue-producing product line
- Signed up major new customer for \$1M worth of business
- Identified new applications, markets, and customers, quantified business opportunities and developed new business
- Wrote new product specifications and marketing materials, and presented to customers
- Resolved applications issues at customer sites and trained customers' staff of field service engineers
- Coordinated communication among customers, sales, R&D, engineering, and manufacturing

Project Leader and Optical Engineer

2002 to 2004

Picarro, Inc., Sunnyvale, CA

- Headed project to develop narrow-linewidth infrared lasers for spectroscopy applications
- Led team of 6 people in new product development program, delivered on time and under budget
- Invented and demonstrated optical designs geared for manufacturing stable, widely tunable lasers
- Invented and developed signal processing tools used to increase manufacturing yield

- Developed and built visible and infrared laser prototypes based on novel architectures

Design Physicist

2000 to 2002

Lightwave Microsystems Corp., San Jose, CA

- Invented microfluidic technology and developed prototypes for use in planar lightwave circuits (PLCs)
- Designed and established new laboratory for research and development in microfluidics and optics
- Led team for development of novel PLCs based on microfluidics
- Designed dynamic PLCs based on silica optical waveguides
- Developed interactive optical modeling tools used to predict the optical performance of PLCs
- Analyzed data on the optical performance of PLCs in order to optimize fabrication processes

Graduate Research Assistant

1994 to 2000

Stanford University, Stanford, CA

- Worked with 1998 Physics Nobel-Prize-winning advisor (Robert B. Laughlin)
- Invented ultrafast light scattering technique to probe microscopic fluid dynamics
- Built laboratory for laser-based research on ultrafast phenomena in fluid dynamics
- Planned, organized, and conducted experiments and computer simulations, analyzed data, and published results
- Trained undergraduates and directed theoretical and experimental student research projects

Graduate Teaching Assistant

1996 to 1999

Stanford University, Stanford, CA

- Led discussion and laboratory sessions and graded assignments for introductory and advanced physics courses

Associate Physicist

1991 to 1994

Exxon Research and Engineering Company, Clinton, NJ

- Conducted x-ray scattering experiments to characterize complex fluids, thin films, and composite materials
- Designed and constructed experimental equipment to study multiphase flow in porous media
- Maintained and repaired x-ray equipment used in analytical studies and product development research

Undergraduate Research Assistant

Summer 1990

Harvard University, Cambridge, MA

- Investigated atomic transport processes in silicon using differential scanning calorimetry

EDUCATION

Ph.D. in Applied Physics

2001

Stanford University, Stanford, CA

Dissertation: Ultrafast optical studies of single-bubble sonoluminescence

M.A. in Physics

1991

Harvard University, Cambridge, MA

Thesis: A laser simulation using SPICE

B.A. in Physics

1991

Harvard University, Cambridge, MA

Cum Laude in General Studies

HONORS AND ACHIEVEMENTS

- Associate Editor, *Cytometry Part A* (Wiley)
- Senior Member, SPIE, 2015
- Volwiler Research Fellow, Abbott Laboratories, 2010
- Senior Member, The Optical Society, 2010
- Top Research Platinum Award for Laser Rastering, Abbott Hematology, 2009

- Silver Award for outstanding technical leadership, Abbott Hematology, 2009
- Abbott Diagnostics Technical Advisory Board Technical Leadership Award Nominee, Abbott Park, 2008
- Communications Director of the United World Colleges National Network, New York, 1991–1994
- Founder and President of the Society for International Education, Harvard University, 1989–1990
- Dean's List of Academic Achievement all semesters, Harvard College, 1987–1990
- Merit-based full scholarship to Lester B. Pearson College, 1985–1987

PROFESSIONAL MEMBERSHIPS

- Reviewer, *Analytical and Bioanalytical Chemistry* (Springer-Verlag), 2018–present
- Instructor, SPIE Short Course, 2015–2018
- Program Committee Member, CYTO International Congress (ISAC), 2013–present
- Reviewer, CYTO International Congress (ISAC), 2013–present
- Member, Consultants' Network of Silicon Valley (IEEE-CNSV), 2011–present
- Member, Bio2Device Group (B2DG), 2011–present
- Reviewer, *Cytometry Part A* (Wiley), 2009–present
- Member, International Society for Advancement of Cytometry (ISAC), 2006–present
- Member, The International Society for Optics and Photonics (SPIE), 2005–present
- Member, The Optical Society (OSA), 1998–present

INTELLECTUAL PROPERTY

1. **G. Vacca**, U.S. patent #10,488,343, "Methods and apparatuses for label-free particle analysis," issued November 26, 2019
2. **G. Vacca**, U.S. patent application, "Methods and apparatuses for label-free particle analysis," filed November 25, 2019 (pending)
3. J. Wu, M. Buhl, **G. Vacca**, U.S. patent #10,481,073, "Basophil analysis system and method," issued November 19, 2019
4. J. Wu, M. Coleman, E. Lin, M. Buhl, **G. Vacca**, U.S. patent #10,481,072, "Nucleated red blood cell analysis system and method," issued November 19, 2019
5. J. Wu, **G. Vacca**, U.S. patent #10,481,071, "White blood cells analysis system and method," issued November 19, 2019
6. J. Wu, M. Buhl, **G. Vacca**, U.S. patent application, "Basophil analysis system and method," filed November 18, 2019 (pending)
7. J. Wu, M. Coleman, E. Lin, M. Buhl, **G. Vacca**, U.S. patent application, "Nucleated red blood cell analysis system and method," filed November 18, 2019 (pending)
8. J. Wu, **G. Vacca**, U.S. patent application, "White blood cells analysis system and method," filed November 18, 2019 (pending)
9. **G. Vacca**, Chinese patent #106,716,108, "Flow cytometry apparatus and methods," issued October 22, 2019
10. M. Krockenberger, D. Garrett, **G. Vacca**, European patent #2,524,222, "Determining volume and hemoglobin content of individual red blood cells," issued July 24, 2019
11. M. Krockenberger, R. Bordenkircher, D. Garrett, J. Glazier, J. Bearden, B. Römer, **G. Vacca**, Canadian patent #2,770,461, "Method for flagging a sample," issued April 23, 2019
12. **G. Vacca**, U.S. patent #10,094,761, "Flow cytometry apparatus and methods," issued October 9, 2018
13. **G. Vacca**, U.S. patent application, "Flow cytometry apparatus and methods," filed October 8, 2018 (pending)
14. **G. Vacca**, U.S. patent #9,952,133, "Particle analysis and sorting apparatus and methods," issued April 24, 2018
15. **G. Vacca**, U.S. patent application, "Particle analysis and sorting apparatus and methods," filed April 23, 2018 (pending)
16. **G. Vacca**, M. Krockenberger, D. Garrett, U.S. patent #9,933,349, "Method for determining volume and hemoglobin content of individual red blood cells," issued April 3, 2018
17. **G. Vacca**, M. Krockenberger, D. Garrett, U.S. patent publication #15/936,128, "Method for determining volume and hemoglobin content of individual red blood cells," filed March 26, 2018 (pending)
18. M. Krockenberger, R. Bordenkircher, D. Garrett, J. Glazier, J. Bearden, B. Römer, **G. Vacca**, Spanish patent #2,654,391, "A method for attaching a flag to a sample," issued February 13, 2018
19. J. Wu, M. Buhl, **G. Vacca**, U.S. patent #9,810,618, "Basophil analysis system and method," issued November 7,

- 2017
20. M. Krockenberger, R. Bordenkircher, D. Garrett, J. Glazier, J. Bearden, B. Römer, **G. Vacca**, European patent #2,470,881, "Method for flagging a sample," issued November 1, 2017
21. J. Wu, **G. Vacca**, U.S. patent #9,797,824, "Method for hematology analysis," issued October 24, 2017
22. J. Wu, **G. Vacca**, U.S. patent application #15/786,899, "Method for hematology analysis," filed October 18, 2017
23. **G. Vacca**, U.S. patent #9,778,193, "Methods and apparatuses for label-free particle analysis," issued October 3, 2017
24. J. Wu, M. Coleman, E. Lin, M. Buhl, **G. Vacca**, U.S. patent #9,778,163, "Nucleated red blood cell analysis system and method," issued October 3, 2017
25. J. Wu, **G. Vacca**, U.S. patent #9,778,162, "White blood cell analysis system and method," issued October 3, 2017
26. J. Wu, M. Buhl, **G. Vacca**, Japanese patent #6,166,716, "Basophils analysis system and method," issued June 30, 2017
27. J. Wu, M. Coleman, E. Lin, M. Buhl, **G. Vacca**, Chinese patent #103,975,054, "Nucleated red blood analysis system and method," issued July 7, 2017
28. **G. Vacca**, U.S. patent #9,671,326, "Flow cytometry apparatus and methods," issued June 6, 2017
29. **G. Vacca**, U.S. patent #9,658,148, "Particle analysis and sorting apparatus and methods," issued May 23, 2017
30. M. Krockenberger, J. Wu, B. Römer, **G. Vacca**, U.S. patent #9,638,621, "Method for discriminating red blood cells from white blood cells by using forward scattering from a laser in an automated hematology analyzer," issued May 2, 2017
31. M. Krockenberger, J. Wu, B. Römer, **G. Vacca**, U.S. patent application #15/581,395, "Method for discriminating red blood cells from white blood cells by using forward scattering from a laser in an automated hematology analyzer," filed April 28, 2017 (pending)
32. **G. Vacca**, European patent application, "Particle analysis and sorting apparatus and methods," filed April 25, 2017 (pending)
33. **G. Vacca**, Japanese patent application, "Particle analysis and sorting apparatus and methods," filed April 25, 2017 (pending)
34. M. Krockenberger, R. Bordenkircher, D. Garrett, J. Glazier, J. Bearden, B. Römer, **G. Vacca**, U.S. patent #9,618,498, "Method for flagging a blood sample," issued April 11, 2017
35. M. Krockenberger, R. Bordenkircher, D. Garrett, J. Glazier, J. Bearden, B. Römer, **G. Vacca**, U.S. patent publication #15/477,994, "Method for flagging a sample," filed April 3, 2017 (pending)
36. J. Wu, **G. Vacca**, Chinese patent #103,987,834, "White blood cells analysis system and method," issued March 29, 2017
37. J. Wu, **G. Vacca**, Japanese patent #6,104,233, "White blood cells analysis system and method," issued March 29, 2017
38. **G. Vacca**, European patent application #15819262.5, "Flow cytometry apparatus and methods," filed February 8, 2017 (pending)
39. **G. Vacca**, U.S. patent #9,551,645, "Flow cytometry apparatus and methods," issued January 24, 2017
40. **G. Vacca**, Canadian patent application #2,954,163, "Flow cytometry apparatus and methods," filed January 3, 2017 (pending)
41. J. Wu, M. Coleman, E. Lin, M. Buhl, **G. Vacca**, Japanese patent #6,029,657, "Nucleated red blood analysis system and method," issued October 28, 2016
42. J. Wu, M. Buhl, **G. Vacca**, Chinese patent #103,917,868, "Basophils analysis system and method," issued August 24, 2016
43. M. Krockenberger, J. Wu, B. Römer, **G. Vacca**, Japanese patent #5,871,792, "In automated hematology analyzers, by using a forward scatter from a laser, a method to determine the red blood cells from white blood cells," issued March 1, 2016
44. M. Krockenberger, J. Wu, B. Römer, **G. Vacca**, U.S. patent #9,267,931, "Method for discriminating red blood cells from white blood cells by using forward scattering from a laser in an automated hematology analyzer," issued February 23, 2016
45. **G. Vacca**, M. Krockenberger, D. Garrett, U.S. patent #9,261,515, "Method for determining volume and hemoglobin content of individual red blood cells," issued February 16, 2016
46. M. Krockenberger, R. Bordenkircher, D. Garrett, J. Glazier, J. Bearden, B. Römer, **G. Vacca**, U.S. patent #9,261,495, "Method for flagging a sample," issued February 16, 2016
47. M. Krockenberger, D. Garrett, **G. Vacca**, Chinese patent #102,933,964, "A method for measuring the volume and hemoglobin content of individual red blood cells," issued October 7, 2015
48. J. Wu, M. Coleman, M. Buhl, **G. Vacca**, E. Lin, U.S. patent #9,103,759, "Nucleated red blood cell analysis system and method," issued August 11, 2015
49. J. Wu, **G. Vacca**, U.S. patent #9,097,704, "Method for hematology analysis," issued August 4, 2015
50. J. Wu, M. Buhl, **G. Vacca**, U.S. patent #9,091,625, "Basophil analysis system and method," issued July 28, 2015

51. J. Wu, **G. Vacca**, U.S. patent #9,091,624, "White blood cell analysis system and method," issued July 28, 2015
52. M. Krockenberger, R. Bordenkircher, D. Garrett, J. Glazier, J. Bearden, B. Römer, **G. Vacca**, U.S. patent #8,911,669, "Method for flagging a sample," issued December 16, 2014
53. M. Krockenberger, J. Wu, B. Römer, **G. Vacca**, U.S. patent #8,906,309, "Method for discriminating red blood cells from white blood cells by using forward scattering from a laser in an automated hematology analyzer," issued December 9, 2014
54. M. Krockenberger, D. Garrett, **G. Vacca**, U.S. patent #8,906,308, "Method for determining volume and hemoglobin content of individual red blood cells," issued December 9, 2014
55. J. Wu, M. Junnarkar, and **G. Vacca**, U.S. patent #8,715,572, "Method and apparatus for detection, analysis, and collection of rare cellular events," issued May 6, 2014
56. **G. Vacca**, Japanese patent #5,465,180, "Count and identification methods and apparatus for high-speed biological particles in the flow," issued April 9, 2014
57. M. Krockenberger, R. Bordenkircher, D. Garrett, J. Glazier, J. Bearden, B. Römer, **G. Vacca**, Japanese patent #5,457,560, "A method for attaching a flag to a sample," issued April 2, 2014
58. J. Wu, M. Coleman, E. Lin, M. Buhl, **G. Vacca**, European patent publication #2705136, "Nucleated red blood cell analysis system and method," filed March 12, 2014 (pending)
59. J. Wu, M. Buhl, **G. Vacca**, European patent publication #2705135, "Basophil analysis system and method," filed March 12, 2014 (pending)
60. J. Wu, **G. Vacca**, European patent publication #2705134, "White blood cells analysis system and method," filed March 12, 2014 (pending)
61. **G. Vacca**, N. Goldblatt, and M. Yee, Japanese patent #5,226,007, "Method and apparatus for rapidly count identify suspended particles by scanning," issued July 3, 2013
62. **G. Vacca**, R. Kendall, N. Goldblatt, M. Yee, and M. Junnarkar, U.S. patent #8,400,632 "Method and apparatus for rapidly counting and identifying biological particles in a flow stream," issued March 19, 2013
63. **G. Vacca**, N. Goldblatt, and M. Yee, U.S. patent #8,253,938, "Method and apparatus for rapidly counting and identifying biological particles in a flow stream," issued August 28, 2012
64. J. Wu, M. Junnarkar, and **G. Vacca**, WIPO patent publication #2012/158826, "Method and apparatus for detection, analysis, and collection of rare cellular events," filed May 16, 2012
65. **G. Vacca**, R. Kendall, N. Goldblatt, M. Yee, and M. Junnarkar, U.S. patent #8,159,670, "Method and apparatus for rapidly counting and identifying biological particles in a flow stream," issued April 17, 2012
66. M. Krockenberger, J. Wu, B. Römer, **G. Vacca**, European patent publication #2425241, "Method for discriminating red blood cells from white blood cells by using forward scattering from a laser in an automated hematology analyzer," filed March 7, 2012
67. J. Wu, **G. Vacca**, WIPO patent publication #2011/140042, "Method for hematology analysis," filed November 10, 2011
68. **G. Vacca**, N. Goldblatt, and M. Yee, U.S. patent #8,045,162, "Method and apparatus for rapidly counting and identifying biological particles in a flow stream," issued October 25, 2011
69. M. Krockenberger, J. Wu, B. Römer, **G. Vacca**, Canadian patent application #2759392, "Method for discriminating red blood cells from white blood cells by using forward scattering from a laser in an automated hematology analyzer," filed November 4, 2010
70. **G. Vacca**, N. Goldblatt, and M. Yee, U.S. patent #7,804,594, "Method and apparatus for rapidly counting and identifying biological particles in a flow stream," issued September 28, 2010
71. **G. Vacca**, WIPO patent publication #2009/061710, "Method and apparatus for rapidly counting and identifying biological particles in a flow stream," filed May 14, 2009
72. **G. Vacca**, Canadian patent application #2704699, "Method and apparatus for rapidly counting and identifying biological particles in a flow stream," filed November 4, 2008
73. **G. Vacca**, N. Goldblatt, and M. Yee, WIPO patent publication #2008/082813, "Method and apparatus for rapidly counting and identifying particles in suspension by scanning," filed July 10, 2008
74. **G. Vacca**, N. Goldblatt, and M. Yee, Canadian patent application #2672883, "Method and apparatus for rapidly counting and identifying particles in suspension by scanning," filed November 20, 2007
75. **G. Vacca**, N. Goldblatt, and M. Yee, European patent application #2097732, "Method and apparatus for rapidly counting and identifying particles in suspension by scanning," filed November 20, 2007
76. A. J. Ticknor, J. T. Kenney, **G. Vacca**, D. A. Saville, and K. G. Purchase, U.S. patent #7,283,696, "Microfluidic control for waveguide optical switches, variable attenuators, and other optical devices," issued Oct. 16, 2007
77. A. J. Ticknor, J. T. Kenney, **G. Vacca**, D. A. Saville, and K. G. Purchase, U.S. patent #7,016,560, "Microfluidic control for waveguide optical switches, variable attenuators, and other optical devices," issued Mar. 21, 2006
78. **G. Vacca**, J. T. Kenney, and D. A. Saville, U.S. patent #6,949,176, "Microfluidic control using dielectric pumping," issued Sep. 27, 2005
79. S. Koulikov, **G. Vacca**, A. Kachanov, B. Richman, B. Kharlamov, G. Knippels, C. Rella, and H. Pham, European

80. patent publication #1560052, "Method and apparatus for adjusting the path of an optical beam," filed Jan. 31, 2005
81. B. Richman, **G. Vacca**, and G. Knippels, U.S. patent publication #2006/0132766, "Continuously tunable external cavity diode laser," filed Dec. 21, 2004
82. S. Koulikov, **G. Vacca**, A. Kachanov, B. Richman, B. Kharlamov, G. Knippels, C. Rella, and H. Pham, U.S. patent publication #2005/0168826, "Method and apparatus for adjusting the path of an optical beam," filed Aug. 3, 2004
83. S. Koulikov, **G. Vacca**, A. Kachanov, B. Richman, B. Kharlamov, G. Knippels, C. Rella, and H. Pham, U.S. patent publication #2005/0168825, "Method and apparatus for adjusting the path of an optical beam," filed Feb. 3, 2004
84. A. J. Ticknor, J. T. Kenney, **G. Vacca**, D. A. Saville, and K. G. Purchase, WIPO patent publication #02/069016, "Microfluidic control for waveguide optical switches, variable attenuators, and other optical devices," filed Feb. 28, 2002
85. **G. Vacca**, J. T. Kenney, and D. A. Saville, WIPO patent publication #02/068821, "Microfluidic control using dielectric pumping," filed Feb. 28, 2002

INVITED TALKS

1. **Speaker**, "Innovative Time-Resolved Approaches to Flow Cytometry," *NIH Flow Cytometry Interest User Group Meeting* (Bethesda, MD, 2019)
2. **Instructor**, "Compensation-Free Flow Cytometry," *6th ESCCA International Summer School on Cytometry* (Valencia, Spain, 2019)
3. **Speaker**, VIP Industry Leaders Speed Meeting Lunch, *CLEO* (San Jose, CA, 2018)
4. **Moderator**, Technology Transfer Program, *CLEO:EXPO* (San Jose, CA, 2018)
5. **Co-chair**, "Flow Cytometry Trends and Drivers," *Workshop at CYTO, the XXXIII International Congress of the International Society for Advancement of Cytometry* (Prague, Czechia, 2018)
6. **Panel Speaker**, "Prospects and Future of Microfluidics," *Photonics West* (San Francisco, CA, 2018)
7. **Speaker**, "Making Every Drop Count in Biomedical Analysis," *IEEE Consultants' Network of Silicon Valley Meeting* (Milpitas, CA, 2017)
8. **Speaker**, VIP Industry Leaders Speed Meeting Lunch, *CLEO* (San Jose, CA, 2017)
9. **Moderator**, Technology Transfer Program, *CLEO:EXPO* (San Jose, CA, 2017)
10. **Panel Speaker**, "Technology and Markets: What bioinstrumentation developers need from the photonics industry," *Laser & Photonics Marketplace Seminar* (San Francisco, CA, 2017)
11. **Short Course Instructor**, "Flow Cytometry Trends & Drivers," *SPIE Photonics West* (San Francisco, CA, 2017)
12. **Panel Speaker**, "Entrepreneurship and Uncertainty," *10th Women Intel Network Conference* (Folsom, CA, 2016)
13. **Mentor**, Health Startups Pitch Sessions, *Startup Weekend Sacramento Health Edition* (Sacramento, CA, 2016)
14. **Short Course Instructor**, "Flow Cytometry Trends & Drivers," *SPIE Photonics West* (San Francisco, CA, 2016)
15. **Panel Speaker**, "Prospects and Future of Microfluidics," *Photonics West* (San Francisco, CA, 2016)
16. **Keynote Speaker**, "System Design Convergence: From Concept to Working Instrument in < 8 Wks," *20th International Conference of the Society for Design and Process Science* (Ft. Worth, TX, 2015)
17. **Chair**, "Flow Cytometry Trends and Drivers," *Workshop at CYTO, the XXX International Congress of the International Society for Advancement of Cytometry* (Glasgow, Scotland, 2015)
18. **Moderator**, Technology Transfer Program, *CLEO:EXPO* (San Jose, CA, 2015)
19. **Short Course Instructor**, "Flow Cytometry Trends & Drivers," *SPIE Photonics West* (San Francisco, CA, 2015)
20. **Speaker**, "Phys-Engi-Preneur: The Neverending Metamorphosis," *Engineers in Medicine and Biology Society Seminar* (Stanford, CA, 2014)
21. **Speaker**, "Human Cell Analysis: The Technology Behind The World's Most Common Diagnostic Test," *IEEE Consultants' Network of Silicon Valley Meeting* (Santa Clara, CA, 2014)
22. **Speaker**, "Gap Between The Optical World and the Mechanical World," *Hyland Optical Lunch & Learn* (Scotts Valley, CA, 2014)
23. **Speaker**, "Phys-Engi-Preneur: The Neverending Metamorphosis," *University of California – Merced Physics Department Colloquium* (Merced, CA, 2014)
24. **Moderator**, Technology Pitch Session, *CLEO:EXPO* (San Jose, CA, 2014)
25. **Moderator**, Technology Transfer Program, *CLEO:EXPO* (San Jose, CA, 2014)
26. **Co-chair**, "New Instruments," *Session at CYTO, the XXIX International Congress of the International Society for Advancement of Cytometry* (Ft. Lauderdale, FL, 2014)
27. **Seminar Instructor**, "Flow cytometry Seminar," *1-day seminar at leading optical sensors company* (California, 2014)
28. **Seminar Instructor**, "Flow cytometry Seminar Series," *2-day site-wide seminar series at leading optics & photonics company* (United Kingdom and Germany, 2014)
29. **Speaker**, "Advances in Optical Design," *Meeting of the Northern California Section of the OSA* (Palo Alto, CA, 2014)
30. **Panel Speaker**, "Prospects and Future of Microfluidics," *Photonics West: MEMS/MOEMS* (San Francisco, CA, 2014)
31. **Speaker**, "Automated Design Tools for Biophotonic Systems," *Photonics West: OPTO* (San Francisco, CA, 2014)

32. **Speaker**, “New Tools for Cell Analysis: High-Throughput Fluorescence Lifetime,” *Leibniz Association Seminar, Deutsche Rheumaforschungszentrum* (Berlin, Germany, 2014)
33. **Speaker**, “Phys-Engi-Preneur: The Neverending Metamorphosis,” *Santa Clara University Physics Department Colloquium* (Santa Clara, CA 2013)
34. **Speaker**, “New Tools for Cancer Research: Probing Cellular Processes at High Throughput,” *Bio2Device Group Seminar Series* (Sunnyvale, CA, 2013)
35. **Co-chair**, “Trends in Cytometry Instrumentation,” *Workshop at the XXVIII International Congress of the International Society for Advancement of Cytometry* (San Diego, CA, 2013)
36. **Panel Speaker**, “Working for Equity: Startup CEOs Share Lessons Learned,” *Silicon Valley Code Camp* (Los Altos, CA, 2012)
37. **Speaker**, “Live Ideas: Interactive Medical Device Simulations,” *IEEE-CNSV Med-SIG Seminar Series* (Santa Clara, CA, 2012)
38. **Speaker**, “System design tools for medical devices and life science instrumentation,” *Bio2Device Group Seminar Series* (Sunnyvale, CA, 2012)
39. **Speaker**, “Looking at cells in a new light: trends and advances in flow cytometry,” *Department of Chemical Engineering, New Mexico State University* (Las Cruces, NM, 2012)
40. **Seminar Instructor**, “Flow cytometry: A technical overview,” *R&D group at leading optics company* (2012)
41. **Seminar Instructor**, “Flow cytometry: A technical overview,” *R&D group at leading test & measurement company* (2011)
42. **Speaker**, “Laser Rastering: Acousto-optical deflectors put to use in medical diagnostics” *19th Annual Symposium of the Great Lakes International Imaging and Flow Cytometry Association* (Detroit, MI, 2010)
43. **Speaker**, “Laser Rastering: technology and applications” *2010 Fall Meeting of the Materials Research Society* (Boston, MA, 2010)
44. **Speaker**, “Laser rastering: Flow cytometry on rocket boosters,” *Center for Biomedical Engineering, University of New Mexico* (Albuquerque, NM, 2009)
45. **Speaker**, “Laser rastering: The opportunity for rare-event analysis and high throughput at warp speed,” *Cancer Research Facility, University of New Mexico* (Albuquerque, NM, 2009)
46. **Speaker**, “Laser rastering flow cytometry: Cell analysis at new orders of magnitude,” *High-Content Analysis East 2009* (Boston, MA, 2009)
47. **Speaker**, “Laser rastering flow cytometry,” *Los Alamos National Laboratory* (Los Alamos, NM, 2008)
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EXHIBIT I



UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/179,586	06/24/2002	John Richard Gilbert	TGZ-012	9/22
959	7590	06/22/2004	EXAMINER	
LAHIVE & COCKFIELD, LLP. 28 STATE STREET BOSTON, MA 02109			CHAMBERS, A MICHAEL	
			ART UNIT	PAPER NUMBER
			3753	

DATE MAILED: 06/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/179,586	Applicant(s) GILBERT ET AL.	
	Examiner A. Michael Chambers	Art Unit 3753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16, 19 and 25-33 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☐ Claim(s) 1-16, 19 and 25-33 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 31 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|-----------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
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Paper No(s)/Mail Date ____ | 6) <input type="checkbox"/> Other: ____ |

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DETAILED ACTION

1. This action is in response to an amendment filed April 26, 2004. Claims 1, 7, 9, 15 and 19 have been amended. Claims 17, 18 and 20-24 have been canceled. Claims 25-33 have been added. An informational disclosure document (IDS) filed July 23, 2003, has previously been examined. Claims 1-16, 19, and 25-33 are pending. Figures 16, and 17 A-C in newly submitted drawings filed March 31, 2004, are the best showings of the instant application microfluidic device.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-6, 19, 25-29, 32 and 33 are rejected under 35 U.S.C. 102(b) as being anticipated by Dunaway. Note Figures 1 in particular in which a “gas-filled reservoirs” 32 and 34 “pressure variation” responsive to fluid pressure valved by solenoid actuated valves shown in Figure 2. See column 48+. Applicants’ remarks, drawn to the teachings of Brown were considered, and in view of amendments to claims 1, 7, 9, 15 and 19 were deemed persuasive. With regard to claims 2 and 3, both a meniscus and bubbles would be a result of actuation of the valves of Figure 2.

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Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

8. The factual inquiries set forth in *Graham v. John Deere Co.*, 148 USPQ 459, that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or unobviousness.

9. Claims 7, 8, 19, 30 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dunaway in view of Cho. Brown discloses a “hydrophobic patch” (125', 126', 127') in column 11, lines 43+. Dunaway discloses the claimed invention except for the recitation of a “movable membrane” as taught by Cho. Note the disclosure in Cho of the diaphragm “actuator” in column 7, lines 4+. A number of actuators are disclosed in column 7, lines 35+ including piezoelectric

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and magnetic. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the microfluidic device of Dunaway to include a “movable membrane” actuator, as taught by Cho in order to provide more effective control of the passage 16, 19 of Dunaway.

Conclusion

11. Claims 4-6 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claims 9-16, which include particular microfluidic device first and second fluid reservoir geometric configuration are allowed.

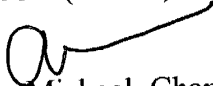
12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The patents to Barth et al, Kim et al(2) and Field et al are of particular interest.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to A. Michael Chambers whose telephone number is 703-308-1016. The examiner can normally be reached on Mon-Thur. 6:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dave Scherbel can be reached on 703-308-1272. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


A. Michael Chambers
Primary Examiner
Art Unit 3753

amc
June 21, 2004

EXHIBIT J



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buff·er | \ 'bə-fər  \

Definition of *buffer*

(Entry 1 of 4)

slang, British

: [fellow](#), [man](#) especially : an old man

buffer

[noun](#) (2), often attributive

Definition of *buffer* (Entry 2 of 4)

1 : any of various devices or pieces of material for reducing shock or damage due to contact

2 : a means or device used as a cushion against the shock of fluctuations in business or financial activity

3 : something that serves as a protective barrier: such as

a : [buffer state](#)

b : a person who shields another especially from annoying routine matters

c : [mediator sense 1](#)

4 : a substance capable in solution of neutralizing both acids and bases and thereby maintaining the original acidity or basicity of the solution also : a solution containing such a substance

5 : a section of computer memory for temporarily storing information especially : one that accepts information at one rate and delivers it at another The streaming video feed continues to download into the buffer while the computer starts playing the movie.

buffer

[verb](#)

buffered; buffering \ 'bə-f(ə-)rɪŋ  \

Definition of *buffer* (Entry 3 of 4)

[transitive verb](#)

1 : to lessen the shock of : [cushion](#)

2 : to treat (something, such as an acid solution) with a buffer also : to prepare (aspirin) with an antacid

3 : to collect (data) in a buffer

buffer

[noun](#) (3)

Definition of *buffer* (Entry 4 of 4)

: one that [buffs](#)

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EXHIBIT K

**IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE**

CYTONOME/ST, LLC,)	CASE NO.: 1:19-cv-00301-RGA
)	
Plaintiff/Counterclaim-Defendant,)	
)	
v.)	
)	
NANOCELLECT BIOMEDICAL, INC.,)	
)	
Defendant/Counterclaim-Plaintiff,)	
)	
)	DEMAND FOR JURY TRIAL
)	
_____)	

DECLARATION OF DINO DI CARLO, PH.D.

I, Dino Di Carlo, Ph.D., declare as follows:

1. I am Dr. Dino Di Carlo. I make this declaration in support of NanoCollect's Sur-Reply Claim Construction Brief in *Cytonome/ST, LLC v. NanoCollect Biomedical, Inc.* (Case No. 1:19-cv-00301-RGA). I have personal knowledge of the facts stated herein and, if called as a witness, I could and would testify competently thereto.

I. BACKGROUND AND QUALIFICATIONS

2. I provide a brief summary of my qualifications below. My qualifications are stated more fully in my *curriculum vitae*, which is attached as Exhibit 1. I am employed at the University of California, Los Angeles in the Department of Bioengineering. As shown in my curriculum vitae, I have more than 15 years of experience in bioengineering and much of my work centers on focusing and sorting particles in microfluidic devices.

3. I obtained a B.S. in Bioengineering from the University of California, Berkeley in 2002. I obtained a Ph.D. in Bioengineering from the University of California, Berkeley in San Francisco in 2006.

4. I completed my post-doctoral training at Harvard Medical School and Massachusetts General Hospital in the Center for Engineering in Medicine.

5. I am currently Vice Chair of the Bioengineering Department at the University of California, Los Angeles. I am also a Professor of Mechanical Engineering and Bioengineering at the University of California, Los Angeles, and Visiting Professor of Chemistry at the University of Tokyo.

6. I am the author of more than 140 peer-reviewed journal publications, many of which relate to focusing particles in microfluidic systems.

7. I currently serve on the Editorial Boards of the journal *Lab on a Chip*. Over the course of my career, I have also served as a journal reviewer for dozens of scientific journals in my fields of study.

8. I also served as a member of the Executive Committee for the Micro Total Analysis Systems ("MicroTAS" or "μTAS") Conference from 2014-2017, which is an annual

conference for reporting research results in microfluidics, microfabrication, nanotechnology, integration, materials and surfaces, analysis and synthesis, and detection technologies for life sciences and chemistry.

9. I am named as an inventor on more than 25 patents.

II. BACKGROUND

A. Materials Considered

10. My opinions are based on my years of education, research and experience, as well as my investigation and study of relevant materials. In forming my opinions, I have considered the materials I identify in this declaration and the following materials:

- The Asserted Patents, namely, the '528, '295, '797, '850, '283, '263, and '188 patents
- The prosecution histories of the Asserted Patents
- Cytonome's Opening Claim Construction Brief dated December 9, 2019
- NanoCollect's Responsive Claim Construction Brief dated January 10, 2020
- Cytonome's Reply Claim Construction Brief dated January 31, 2020, and exhibits thereto
- Declaration of Giacomo Vacca, Ph.D. in support of Cytonome's Reply Claim Construction Brief dated January 31, 2020

11. This declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

B. Compensation

12. I am being compensated at a rate of \$550 per hour for my study and testimony in this matter. I am also being reimbursed for reasonable and customary expenses associated with my work and testimony in this matter. I have no personal financial interest in any of the entities involved in this proceeding. My compensation is not contingent upon the outcome of this matter or the specifics of my testimony.

C. Prior Testimony

13. I have provided expert testimony in the following matters:

IPR2017-02162

IPR2017-02097

Inguran, LLC v. ABS Global, Inc., No. 17-cv-446-WMC (W.D. Wis.)

III. PERSON OF ORDINARY SKILL IN THE ART

14. I understand that a person of ordinary skill in the art (“POSA”) is a hypothetical individual presumed to have the same level of skill as the typical practitioner of the art at issue at the time of the invention. I understand that the POSA is also presumed to be aware of all the pertinent prior art.

15. I have been asked to consider the level of ordinary skill in the art as of April 17, 2002, which I understand is the earliest priority date claimed by each of the Asserted Patents except for the ’188 patent. My opinion as to the level of ordinary skill in the art does not materially change if the temporal lens is changed to that of December 3, 2004, which is the earliest priority date claimed by the ’188 patent.

16. I have been advised that, in determining the level of ordinary skill in the field that someone would have had at the time the claimed invention was made, I should consider: (1) the levels of education and experience of persons working in the field; (2) the types of problems encountered in the field; and (3) the sophistication of the technology. In my opinion, a person of ordinary skill in the art at the relative time would have had a bachelor’s or master’s degree in the field of bioengineering, mechanical engineering, chemical engineering, or analytical chemistry; or a bachelor’s or master’s degree in a related field and at least three years of experience in designing or developing microfluidic systems.

IV. LEGAL STANDARDS

17. For my opinions in this declaration, I understand that various legal principles apply. I am not an attorney, but have been informed by counsel of the legal principles relevant to my analysis. I have applied my understanding of those legal principles in forming my opinions.

18. For example, I have been informed that a claim term is to be given the meaning that a POSA, at the time of invention would understand it to have, as used in the patent claims at issue, and in the context of the entire patent (including the specification). I also understand that a patent applicant may use a term in a manner that differs from the ordinary meaning of that term (as would have been understood by a POSA) if the patent sets out that different meaning in a manner that is sufficient to inform a POSA that the different meaning applies.

19. I also understand that to redefine a term and therefore act as a lexicographer, a patentee must clearly set forth a definition of the disputed claim term or express a clear intention to redefine the term. To effectively assign its own definition to a claim term, an inventor does not have to expressly state in the specification that a term is being given its own special definition so long as the definition is readily apparent from the specification.

20. I have been informed that, in endeavoring to understand the meaning of a claim term, the most significant evidence to be referenced is the patent itself (including the specification and patent claims) and the prosecution history of the patent. I also understand that other evidence that is not part of the patent or its prosecution history, such as scientific articles, is generally considered less significant for purposes of interpreting claim language.

21. I have been informed that the claims of a patent define the scope of patent rights, and that claims must be read from the viewpoint of a POSA. I also understand from counsel that claim language should be interpreted in accordance with its ordinary and customary meaning unless the patent or prosecution history unambiguously dictates that a different claim meaning was intended.

22. I have been informed that a claim construction that does not include preferred embodiments disclosed in a patent specification is rarely, if ever, correct. Likewise, claims should not be construed to render the invention inoperable.

23. I have been informed that claims are to be construed so as to preserve their validity if there is an ambiguity that might render the claim invalid or the application of other claim construction doctrines does not resolve the issue.

24. I have been informed that dependent claims incorporate all of the limitations of the claims from which they depend.

25. I have been informed that dependent claims are generally narrower in scope than the claims from which they depend, but that this principle may not be used to broaden claims beyond their correct scope and meaning in light of the patent as a whole.

26. I have been informed that a claim is indefinite if, when read in light of the specification and the prosecution history, it fails to inform, with reasonable certainty, a POSA about the scope of the invention.

27. I have applied the foregoing legal standards in my evaluation of the disputed claim terms and following opinions.

V. DISPUTED CLAIM TERMS

A. “absorbing” and variants including “absorb”

28. The term “absorbing” (and variants, such as “absorb”) is used in the ’528 patent, claims 18 and 22; ’295 patent, claims 1 and 9; ’797 patent, claims 1 and 18; ’850 patent, claim 1; and ’263 patent, claims 1 and 15.

29. In my opinion, a POSA would have understood the term “absorb” to mean “to receive without recoil or echo,” which, at a minimum, prevents disturbance to the flow of the non-selected particles.

30. After reviewing the claims and specifications of the Asserted Patents, it is my opinion that the “buffer” functions to prevent a flow disturbance within a flow channel caused by a pressure pulse. A POSA would have understood that such a disturbance to the flow of non-selected particles would be caused by the echo or recoil of the pulse within the microfluidic device. Thus, in order to prevent a pressure pulse from disturbing the flow of non-selected particles, the claimed device reduces the amount of kinetic energy of fluid associated with the pressure pulse that would otherwise recoil or echo within the microfluidic device. To do that, the device seeks to “dampen” or “absorb” the kinetic energy of the pressure pulse.

31. With the exception of the asserted claims of the '528 patent, every single asserted claim that recites the term “absorb” also recites the term “dampen” (e.g., “absorbing or dampening”). As a result, a person of ordinary skill in the art would have understood that “dampen” and “absorb” do not mean the same thing. If they meant the same thing, there would have been no reason to recite both terms with the word “or” in between. The Applicant would have simply used only one of the terms to effect the same meaning, instead.

32. I understand that, as used in the Asserted Patents, “absorb” and “dampen” refer to differences in degree of the same physical phenomenon—the dissipation of energy. In light of the claims and specifications of the Asserted Patents, I understand that “absorb” refers to a larger dissipation of energy than “dampen.” Given that the terms were used as alternates in the Asserted Claims, presumably directed towards the working of the claimed inventions, I understand that “dampen” refers to a partial, yet meaningful dissipation of energy, as I discuss below, and “absorb” means “to receive without recoil or echo.”

33. Further, the dictionary definition of “absorb” is “to receive without recoil or echo.” Ex. D to NanoCollect’s Responsive Claim Construction Brief. Dr. Vacca states that a “person of skill would not understand the term ‘absorbing’ to preclude any and all rebound or echo.” Dec, ¶ 51. In my opinion, a POSA would not understand this dictionary definition of “absorb” “to receive without recoil or echo” as requiring absolutely perfect dissipation. Rather, in the context of the claims and specifications of the Asserted Patents, a POSA would have understood that “absorb” means that the pressure pulse is sufficiently dissipated such that it is prevented from influencing the flow channel containing the particles. A POSA would have understood that no process is perfect or perfectly efficient, and some degree of recoil or echo is unavoidable.

34. Dr. Vacca seems to suggest that “absorb” and “dampen” mean the same thing. *See, e.g.*, Dec, ¶ 14 *citing* '263 patent, 11:20-25 (“the ‘dampening’ claim term is met if, like ‘absorbing,’ the dampening is sufficient to ‘prevent[] a pressure wave . . . from . . . affecting the flow of the remaining particles in the stream of particles.’”). As I mentioned above, all but the

asserted claims of the '528 patent recite the term “dampening” in addition to “absorbing.” There would be no need to recite both terms in the alternative in the vast majority of the Asserted Claims if the words mean the same thing.

35. Dr. Vacca “generally agree[s] that “a POSA would understand that absorption of a pressure pulse prevents disturbance to the flow of the non-selected particles in the stream of particles.” Dec, ¶ 50. Thus, Dr. Vacca appears to agree that “absorption” requires the dissipation of energy.

36. I understand that Cytonome alleges that NanoCollect cherry-picked a definition that would most limit the patented inventions. Reply Brief at 2. Cytonome also appears to allege that NanoCollect should have selected the first dictionary definition, “to take in (something, such as water) in a natural or gradual way,” instead. I disagree. As with Cytonome’s preferred construction, the dictionary definition “to take in (something, such as water) in a natural or gradual way,” lacks any relationship to the dissipation of energy. Instead, it refers to taking in matter, like liquid. Each of the examples of the word “absorb” used in a sentence in a manner consistent with “to take in (something, such as water) in a natural or gradual way” (“a sponge absorbs water,” “charcoal absorbs gas,” and “plant roots absorb water”) is more analogous to “soaking something up” than dissipating energy.

37. A POSA would not understand the meaning of “absorb” as used in the Asserted Patents based on the definition “to take in (something, such as water) in a natural or gradual way.” Cytonome’s preferred dictionary definition fails to inform a POSA of the substance or property that the buffer “absorbs.” Cytonome does not dispute that the buffer dissipates kinetic energy when it “absorbs” a pressure pulse. Pressure is a force per unit area. Thus, the buffer is claimed to “absorb” the force (pressure pulse) through energy dissipation and not “absorb” the fluid like a sponge.¹ In contrast, NanoCollect’s construction is consistent with the claims and

¹ While the '528 patent describes a displacement component in discussing the buffer, the property being absorbed is *pressure*, not fluid. See the '528 patent, 12:25-34 (“The activation of the first bubble valves causes a transient pressure variation in the first side passage 174a. The second side passage 174b and the second bubble valve 10b absorb the transient pressure variations in the measurement duct 166 (continued...)”)

specifications of the Asserted Patents because it relates to energy dissipation of the pressure pulse by “absorption.” I believe the discussion provided above sufficiently demonstrates why a POSA would have understood that “absorb” means “to receive without recoil or echo” in the context of the Asserted Patents. I further address my disagreements with Dr. Vacca’s characterizations of the evidence that he provides as supporting that the plain and ordinary meaning of “absorbing” is “to ‘take up’ or ‘take in,’” in additional detail below. Dec, ¶ 50.

38. Dr. Vacca asserts that the specification of the ’850 patent demonstrates that “the patentees contemplated different levels of ‘absorption’ for different applications” because the specification of the ’850 patent includes a description of the spring constant and discussion about the resiliency of the buffer. Dec, ¶ 53. For the purposes of claim construction, I note that claim 1 of the ’850 patent recites, in part, “a buffer configured to fluidically co-operate with the actuator for absorbing or dampening the pressure pulse to allow other particles in the stream of particles to normally flow into the first outlet while the deflected particle flows into the second outlet.” ’850 patent, cl. 1. The claimed buffer can “absorb” or “dampen” the pressure pulse. Thus, even under NanoCollect’s proposed constructions, claim 1 of the ’850 patent already encompasses incomplete dissipation so long as the buffer dissipates enough energy to prevent the recoil or echo of the pressure pulse from affecting the flow of the remaining particles. Dr. Vacca seems to agree with that position. *See, e.g.* Dec, ¶¶ 50 and 55.

B. “dampening” and variants “dampen”

39. Defendant’s construction of “dampen” to mean “to meaningfully dissipate” should be adopted because it is consistent with a POSA’s understanding of the term in light of the claims and specifications of the Asserted Patents. Cytonome’s expert appears to agree with this construction. *See* Dec, ¶ 56 (“After reviewing the claims and specifications, I do not find unreasonable NanoCollect’s proposal to construe ‘dampen’ as ‘to meaningfully dissipate.’”).

induced via the actuator 176. Basically, the reservoir 70b of the second bubble valve 10b is a chamber having a resilient wall or contains a compressible fluid such as a gas. The resilient properties allow the flow of liquid from the measurement duct into the second side passage 174b.” (emphasis added)).

40. NanoCollect's proposed construction defines the upper and lower limits of the amount of dissipated energy required to "dampen" a pulse. "Dampen," *i.e.*, meaningful dissipation, would not cover incidental dissipation. In every fluidic system, flowing fluid generates some friction between layers of fluid and, therefore, viscous dissipation of energy. Every fluidic system and every component, therefore, "dampens" to a certain extent.

41. I agree with Dr. Vacca that the Asserted Patents provide that "dampening" requires dissipating enough energy so as to "prevent[] a pressure wave ... from ... affecting the flow of the remaining particles in the stream of particles." Dec, ¶ 57 *citing* '263 patent, 11:20–25. In other words, the amount of energy that recoils or echoes should be reduced enough that it does not create a disturbance to the flow of non-selected particles.

42. As I stated above, a POSA would have understood that, as used in the Asserted Patents, "absorb" and "dampen" refer to differences in degree of the same physical phenomenon: the dissipation of energy. A POSA would also understand that "absorb" refers to a larger dissipation of energy than dampen and "dampen" would mean less dissipation, yet still require "meaningful" dissipation so as to prevent the recoil or echo of the pressure pulse from affecting the flow of the non-selected particles.

C. "dampening or absorbing the pressure pulse using a first reservoir in fluid communication with the microfluidic flow channel" ('797 Patent, claim 1)

43. This claim term incorporates several terms that the parties dispute. Rather than restate my analysis here, I incorporate by reference my analysis of "dampening," "absorbing," and "pressure pulse."

D. "dampening or absorbing the pressure pulse using [a/the] first reservoir" ('797 Patent, claims 1 and 18)

44. This claim term incorporates several terms that the parties dispute. Rather than restate my analysis here, I incorporate by reference my analysis of "dampening," "absorbing," "pressure pulse."

E. “buffer” (’528 Patent, claims 18, 22, and 24)

45. A POSA reading the ’528 patent’s claims would have understood the claim language as functional requiring corresponding structure to work. Thus, a POSA would have to refer to the written description in the ’528 patent in order to find a structure for “buffer.”

46. Yet, the term “buffer” never appears in the specification of the ’528 patent. Each of the quotations Cytonome’s expert, Dr. Vacca, uses from the specification of the ’528 patent only ever refers to a “bubble valve,” not a “buffer.” *See, e.g.*, Dec, ¶ 36 (“The second side passage 174*b* and the second bubble valve 10*b* absorb the transient pressure variations in the measurement duct 166 induced via the actuator 176.”).

47. In fact, Cytonome states that the only disclosure in the specification of the ’528 patent related to absorbing pressure pulses does not refer to a “buffer.” *See* Reply Brief at 1 (“the only mention of the word ‘absorb’ in the ’528 Patent’s specification: ‘The second side passage 174*b* and the second bubble valve absorb the transient pressure variations in the measurement duct . . . The resilient properties [of the reservoir] allow the flow of liquid into the second side passage.’” *citing* ’528 patent, 12:28-34).

48. As functionally claimed, a POSA would not have understood a bubble valve alone to be a “buffer.” Additionally, in my opinion, a bubble valve is not a “buffer” as used in the ’528 patent. A bubble valve can actively control fluid flow, while a “buffer” functions to absorb a pressure pulse.

49. Cytonome’s own construction, “a physical structure that contains a fluid and receives a pressure pulse,” also seems to conclude that a “buffer” is a physical structure defined by its function: receiving a pressure pulse.

50. The term “physical structure” does not define any particular “physical structure” that serves to buffer a pressure pulse. As I discuss in detail below, claim 18 of the ’528 patent requires that “buffer” be “for absorbing the pressure pulse.” Numerous structures in the ’528 patent are “physical structures that contain fluid and receive a pressure pulse.”

51. Dr. Vacca points to a structure filled with air in U.S. Patent No. 5,777,649 to Otsuka (“Otsuka”) as an example of a “buffer chamber” or “buffering chamber.” Dec, ¶ 38. The only common structure between the “buffer chamber” in Otsuka and the bubble valve that Vacca asserts is a buffer in the ’528 patent have is that they are both filled with air. *Compare* Dec., ¶ 38, with ¶ 35.

52. Dr. Vacca defines a “buffer” as “something that absorbs or mitigates variations.” Dec, ¶ 39. Yet Dr. Vacca fails to define what that “something” is or how to identify it. Cytonome even defines the amount of absorption required functionally. According to Dr. Vacca, it is “whatever absorption is necessary for the given application.” Reply Brief at 1.

53. Dr. Vacca provides examples of buffers in chemistry for managing pH, electronics for managing load, and mechanical engineering for managing vibrations. *See* Dec, ¶ 39. I am familiar with each of these uses of the term “buffer,” but the claimed invention does not use any one of these examples. I do not disagree with Dr. Vacca that the term “buffer” is commonly used in chemistry, electronics, and mechanical engineering. However, none of Dr. Vacca’s examples from other fields involve flowing fluids at all, let alone pressure pulses or microfluidic devices.

54. A POSA would understand that the intrinsic evidence clearly links and associates the gas-filled structure, side channels, and meniscus to the claimed functions. A POSA would understand that these structures are corresponding structures to achieve the claimed functions.

55. The components in the specification of the ’528 patent that describe structures that could absorb pressure pulses include a gas-filled reservoir, a side channel, and a meniscus. *See, e.g.*, 70 (described as 70*b*), 10*b*, 174*b*, and 175 in Fig. 16.

F. “a first reservoir operatively associated with the flow channel and adapted for dampening or absorbing a pressure pulse propagated across the flow channel” (’295 Patent, claim 1)

56. A POSA reading the ’295 patent’s claim 1 would have understood the claim language as functional requiring corresponding structure to work. Thus, a POSA would have to refer to the written description in the ’295 patent in order to find structure of “reservoir.”

57. A POSA would have readily understood that the reservoir as claimed cannot inherently dampen or absorb a pressure pulse. For example, rigid glass materials forming a reservoir are often used to propagate ultrasonic pressure pulses with minimal dissipation. Similarly, microfluidic devices often use reservoirs to introduce fluids or reagents, in which case absorption of a pressure pulse would be counter to the purpose of moving the reagents through the device. Other reservoirs are used to mix reagents. Such reservoirs are often adapted to blend reagents using vibrations or fluid flow. These examples are, therefore, reservoirs that are *not* adapted to dampen or absorb a pressure pulse. Thus, the term “reservoir” is insufficient on its own to perform the function of “dampening or absorbing a pressure pulse.”

58. Cytonome’s proposed construction for a “reservoir” is “a physical structure that contains fluid.” Thus, Cytonome’s proposed construction fails to describe the “physical structure” of a reservoir as anything more specific than a “physical structure.” The “physical structure” of a reservoir according to Cytonome encompasses anything and everything that “contains a fluid.” A POSA would have understood that containing a fluid is not the same as absorbing or dampening the pressure pulse.

59. Furthermore, the mere fact that the claims indicate that the claimed reservoirs are “adapted for dampening or absorbing a pressure pulse” is an implicit recognition that reservoirs cannot inherently absorb pressure pulses without further structures. A POSA would have understood that the intrinsic evidence clearly links and associates the gas-filled structure, side channels, and meniscus to the claimed functions. A POSA would understand that these structures are corresponding structures to achieve the claimed functions.

60. The components in the specification of the ’528 patent that describe structures that could absorb pressure pulses include a gas-filled reservoir, a side channel, and a meniscus. *See, e.g.*, 70 (described as 70*b*), 106, 174*b*, and 175 in Fig. 16 and Fig. 17.

G. “a first reservoir . . . adapted for dampening or absorbing a pressure pulse” (’295 Patent, claim 1)

61. The phrase “a first reservoir . . . adapted for dampening or absorbing a pressure pulse” of the ’295 patent is included in the claim phrase I analyzed above. Accordingly, the arguments above for the claim phrase “a first reservoir operatively associated with the flow channel and adapted for dampening or absorbing a pressure pulse propagated across the flow channel” in claim 1 of the ’295 patent also apply here.

62. A POSA would understand that the intrinsic evidence clearly links and associates the gas-filled structure, side channels, and meniscus to the claimed functions. A POSA would understand that these structures are corresponding structures to achieve the claimed functions.

63. The components in the specification of the ’528 patent that describe structures that could absorb pressure pulses include a gas-filled reservoir, a side channel, and a meniscus. *See, e.g.*, 70 (described as 70*b*), 106, 174*b*, and 175 in Fig. 16 and Fig. 17.

H. “buffer” (’850 Patent, claims 1 and 11)

64. Like the ’528 patent, a POSA reading the ’850 patent’s claims would have understood the claim language as functional requiring corresponding structure to work. For instance, in claim 1 of the ’850 patent, the function is to “fluidically co-operate with the actuator for absorbing or dampening the pulse.” This is consistent with Cytonome’s proposed construction of a “buffer” in the 850 patent, which is “a physical structure that contains fluid and receives a pressure pulse.”

65. Indeed, even Cytonome’s own proposed construction describes “buffer” in functional terms as containing a fluid and receiving a pressure pulse is a function.

66. Thus, like the ’528 patent, a POSA would have had to refer to the written description in the ’850 patent in order to find a structure of a “buffer.”

67. A POSA would understand that the intrinsic evidence clearly links and associates the gas-filled area, side channels, and meniscus to the claimed functions. A POSA would understand that these structures are corresponding structures to achieve the claimed functions.

68. As I stated above, in my opinion, a POSA would not equate a bubble valve with the claimed “buffer.”

69. That being said, a bubble valve is the only structure that the specification of the ’850 patent indicates is capable of absorbing a pressure pulse. *See, e.g.*, ’850 patent, 6:24-26 (“The second bubble valve 100a serves as a buffer for absorbing the pressure pulse created by the first bubble valve 100b.”); 9:48-51 (“The buffer bubble valve 100b is positioned to absorb the pressure wave created by the pressure wave generator 260 to prevent flow disturbance in the other particles of the particle stream.”); 7:28-31 (the “second side passage 24a and the second bubble valve 100a absorb the transient pressure variations in the measurement duct 16 induced via the actuator”).

70. These features correspond to components 70a, 100a, 24a, and 25 as disclosed by the specification. *See* ’850 patent at 6:33-36 (“a buffer chamber 70a in the second bubble valve 100a for absorbing pressure transients”); 7:31-37 (“Basically, the reservoir 70a of the second bubble valve 100a is a buffer chamber having a resilient wall or containing a compressible fluid, such as a gas.”).

71. A POSA reading the ’850 patent’s claims would have understood the claim language as functional requiring corresponding structure to work. Thus, a POSA would have to refer to the written description in the ’850 patent in order to find structure of “buffer.”

I. “a reservoir adapted for dampening or absorbing the transient pressure pulse” (’263 Patent, claim 1)

72. A POSA reading the ’263 patent’s claims would have understood the claim language as functional requiring corresponding structure to work. A POSA would readily understand that a “reservoir” cannot inherently generate a pressure pulse, as described above. For example, Dr. Vacca states that a “reservoir” and a “chamber” have the same meaning. Dec, ¶ 49. Not all reservoirs are adapted to dampen or absorb a pressure pulse even in the context of Cytonome’s asserted patents. One example is the sample input chamber 112 in Fig. 13 of the ’188 patent. This reservoir 112 is labeled “cell source” and is for storing a sample to be

processed. '188 patent at 9:63-67. As a result, a POSA would not understand this reservoir to be a “reservoir” adapted for generating a pressure pulse. Here, a POSA would have to refer to the written description in the '263 patent in order to find structure for “reservoir.”

73. A POSA would understand that the intrinsic evidence clearly links and associates the gas-filled structure, side channels, and meniscus to the claimed functions. A POSA would understand that these structures are corresponding structures to achieve the claimed functions. The components in the specification of the '263 patent that describe structures that could absorb pressure pulses include a gas-filled reservoir, a side channel, and a meniscus. *See, e.g., 70a, 100a, 25a, and 24a* in Figure 1. A POSA would have understood that these structures are necessary for the same reasons discussed in Section H, above.

J. “a reservoir . . . to dampen or absorb a transient pressure pulse” ’(263 Patent, claim 15)

74. My analysis above for the claim phrase “a reservoir adapted for dampening or absorbing the transient pressure pulse” in claim 1 of the '263 patent also applies here for claim 15 of the '263 patent.

K. “a second reservoir . . . adapted for generating the pressure pulse” ’(295 Patent, claim 1)

75. A POSA reading the '295 patent’s claim 1 would have understood the claim language as functional requiring corresponding structure to work. Thus, a POSA would have to refer to the written description in the '295 patent in order to find structure of “reservoir” for “generating the pressure pulse.”

76. A POSA would readily understand that a “reservoir” cannot inherently generate a pressure pulse. For example, Dr. Vacca states that a “reservoir” and a “chamber” have the same meaning. Dec, ¶ 49. Not all reservoirs are adapted for generating a pressure pulse, as evidenced other reservoirs described in Cytonome’s own asserted patents. One example is the sample input chamber 112 in Fig. 13 of the '188 patent This reservoir 112 is labeled “cell source” and is for storing a sample to be processed. '188 patent at 9:63-67. As a result, a POSA would not understand this reservoir to be a “reservoir” adapted for generating a pressure pulse. Here, a

POSA would have to refer to the written description in the '295 patent in order to find structure for “reservoir.”

77. A POSA would have understood that the intrinsic evidence clearly links and associates the fluid-filled structure and side channels to the claimed functions. A POSA would understand that these structures are corresponding structures to achieve the claimed functions. The structure understood by the POSA to have a sufficiently definite structure to perform the stated function would include at least components 10a, 70, and 174a of the '295 patent.

L. “a reservoir . . . adapted for originating the transient pressure pulse” ('263 Patent, claim 5)

78. A POSA reading the '263 patent's claim 1 would have understood the claim language as functional requiring corresponding structure to work. Thus, a POSA would have to refer to the written description in the '263 patent in order to find structure of “reservoir” for “originating the transient pressure pulse.”

79. A POSA would understand that the intrinsic evidence clearly links and associates the fluid-filled structure and side channels to the claimed functions. A POSA would understand that these structures are corresponding structures to achieve the claimed functions. The structure in the specification that would allow “a reservoir . . . adapted for originating the transient pressure pulse” to be understood by the POSA to have a sufficiently definite meaning is 100b, 70b, and 24b.

M. “a reservoir . . . to originate the transient pressure pulse” ('263 Patent, claim 16)

80. My analysis above for the claim phrase “a reservoir . . . adapted for originating the transient pressure pulse” in claim 5 of the '263 patent also applies here for claim 16 of the '263 patent.

N. “an actuator connected to the first side channel” ('528 Patent, claim 22)

81. This element as used in claim 22 of the '528 patent is indefinite because the specification and claims of the '528 patent do not identify any actuator connected to the first side channel. A person of ordinary skill in the art would have understood that the word “connected”

means a physical connection. In other words, the actuator would be in physical contact with the side channel.

82. Cytonome argues that “Figures 16-17C ... [show] an actuator 176 *connected to a bubble valve 10a* that includes a side passage 174a.” Reply Brief at 12 (emphasis added). These figures do not show an actuator connected to a side channel. The figures show an actuator that activates reservoir 70 of the bubble valve, not the side channel.

O. “chamber” (’850 Patent, claims 10 and 11)

83. The word “chamber” has a plain and ordinary meaning. A POSA would have understood that, in the context of a microfluidic device, a chamber is a void or container. There is no requirement that a chamber hold fluid because some chambers can be “vacuum chambers,” which hold nothing, and other chambers can hold solids, such as solid reagents that can be dissolved during use. If the claimed chamber was limited to contain fluid but not vacuum or solids, the claims would have recited as much.

P. “otherwise sealed” (’283 Patent, claims 1 and 6)

84. Claim 1 of the ’283 patent recites the element, “the first chamber in fluid communication with the duct via a first side opening and otherwise sealed.” The term “otherwise sealed” does not appear anywhere in the ’283 patent except within the claims. A POSA would have understood that “otherwise sealed” means “otherwise closed off from fluid connection” in view of the plain language of the claims, the specification, and the prosecution history. In the context of the plain language of the claim, a POSA would have understood that the first chamber includes one, and only one, side opening, which opening is in fluid communication with the duct. In other words, the first chamber in claim 1 is completely sealed off from fluid connection with a single exception: the duct via a first side opening.

85. This interpretation is supported by the specification of the ’283 patent, which says that a particle sorting system includes “a sealed chamber positioned adjacent the side channel, wherein the carrier fluid *forms a meniscus in the side channel to separate the sealed chamber from the carrier fluid.*” ’283 patent, 4:41-44 (emphasis added). This means that the gas within

the chamber is sealed off and prevented from escaping the chamber by the meniscus. The carrier fluid flows through the duct of the system. *See id.*, 7:9-12. The meniscus separates the chamber from the carrier fluid in the rest of the device. The meniscus is the gas/liquid interface in the side channel. The specification identifies both the seal (the meniscus), and what the chamber is being sealed from (the carrier fluid). The gas and liquid are both fluids that can shift within the side channels and, therefore, the meniscus allows the chamber to remain in fluid communication with the duct while retaining (or sealing) the gas inside the chamber. A POSA, therefore, would have understood that such a chamber is “otherwise sealed,” meaning the chamber is “otherwise closed off from fluid connection.”

86. Given the literal meaning of the phrase “otherwise sealed,” and that the claims themselves do not specify that the claimed first chamber is otherwise sealed from an exterior environment, and that the specification of the ’283 patent does not teach sealing the chamber from an exterior environment, a POSA would not have considered “otherwise sealed” to refer to sealing from an exterior environment. As a result, A POSA would have understood that “otherwise sealed” means “otherwise closed off from fluid connection.”

Q. “carrier fluid” (’528 Patent, claims 18 and 22)

87. A POSA would have understood “carrier fluid” to mean “fluid containing the particles moving through the system.” A POSA would have understood carrier fluid need not surround a particle in the system in order to be characterized as “carrier fluid.”

88. The microfluidic systems described and claimed in the ’528 patent rely upon laminar flow to keep the stream of particles focused in the center of the measurement duct 166. As such, the sorting system depicted in Figure 16 includes “a first supply duct 162 for introducing a stream of particles and a second supply duct 164 for supplying a carrier liquid. The first supply duct 162 ends in a nozzle, and a stream of particles is introduced into the flow of carrier liquid.” ’528, 11:53-57. Thus, the ’528 patent indicates that the carrier fluid is introduced without the particles. This is consistent with a POSA’s understanding that carrier fluid need not surround a particle to be “carrier fluid.”

89. Cytonome's proposed construction is narrower than what would be understood by a POSA and narrower than the terms used in the specification because it requires that the fluid surround the particle. Cytonome's construction for this term from the claims of the '528 patent comes from the later-filed '850 patent. The '850 patent is a CIP of US Patent Application No. 10/179,488, which claims priority to the same provisional application as the '528 patent. The disclosures in the two patents also differ quite a bit. The written description of the '528 patent is largely directed to early embodiments of Cytonome's bubble valves and their uses to block fluid flow in capillary tubes as well as a single sorting embodiment. The written description of the '850 patent includes additional sorting embodiments.

90. The inventors of the two patents also differ. The '528 patent lists John Richard Gilbert, Sebastian Bohm, and Manish Deshpande as inventors. In contrast, the '850 patent lists John R. Gilbert and Manish Deshpande as inventors.

R. "pressure pulse"

91. A POSA reviewing the Asserted Patents would have understood the term "pressure pulse" to be "a unidirectional flow to the [microchannel/supply duct]. Cytonome argues that NanoCollect's construction should be rejected because it would improperly exclude a single embodiment of a single patent. RB at 4. A POSA would have understood that the embodiment described in Figure 6 is an alternative embodiment. What's more, the '850 patent discloses this alternative embodiment that must have "a plunger that can act upon the flowing liquid . . . to selectively deflect particles." A POSA would have understood that "a plunger" would create a unidirectional flow toward the buffer because, if it did not, any displacement or pulses would radiate out in the shape of a circle like a pebble dropped in a pond. There would be no way to control such a displacement or pulse, which would impact particles both upstream and downstream of the actuator. As such, the bubble valve on the opposing side of the channel could not absorb or dampen the pulse because only a small fraction of the pulse would be directed towards the bubble valve.

S. “from the stream of particles” (’528 Patent, claims 18 and 22 and ’188 Patent, claims 1 and 12)

92. As described above, a POSA would have understood that microfluidic cell sorting systems use laminar flow in order to focus the cells in the middle of the flow channel. Laminar flow occurs when a fluid flows in parallel layers, with no disruption between the layers. Each of the layers in laminar flow constitutes a stream. Cell samples are typically prepared by staining the cells in a fluid. For simplicity, I will refer to the fluid containing the sample of cells as “sample fluid” to distinguish it from the “carrier fluid” introduced by the second supply duct 164 in the ’528 patent. A POSA would have understood that the particles cannot be introduced by themselves, they must be introduced using a fluid, which is generally the sample fluid. As a result, cell sorters typically draw up the cells while they are still suspended in the sample fluid and then combine the sample fluid containing the cells with other streams of fluid to generate the desired laminar flow.

93. Figure 16 of the ’528 patent demonstrates how this is achieved: the “channel system comprises a first supply duct 162 for introducing a stream of particles and a second supply duct 164 for supplying a carrier liquid. The first supply duct 162 ends in a nozzle, and a stream of particles is introduced into the flow of carrier liquid.” ’528 patent, 11:53-57. Thus, the stream of particles is already in a continuous moving procession of sample fluid and particles before it is introduced into the carrier fluid. Introducing the stream of particles into the carrier fluid hydrodynamically focuses the stream. Such a construction is entirely consistent with both a POSA’s understanding of the phrase “stream of particles” and the specification of the ’528 patent.

94. A POSA would also understand the term “stream of particles” to mean that several particles are in the flow channel simultaneously. Otherwise, the claim would only recite one cell or a plurality of cells. Because the several cells are focused in a straight line as a result of the laminar flow, a POSA would have understood that the stream of particles is a “procession” of particles, consistent with NanoCollect’s proposed construction.

95. Finally, a POSA would have understood that the full phrase “from the stream of particles” means that a selected particle is removed from one of the layers of the laminar flow – in this case, the sample fluid – by deflecting the particle into one of the surrounding layers of carrier fluid. Cytonome even admitted as much when they argued that states, unlike the claimed invention, “[t]here is no teaching or suggestion in Dunaway that *a selected particle can be separated from the stream of fluid* flowing through the fluid amplifier.” See Ex. F at CYTLLC_001298 (emphasis added). The USPTO allowed the ’586 application as a result of this Response. See *id.* at CYTLLC_001279-282. Thus, a POSA would have understood “from the stream of particles” means “from the continuous moving procession of fluid and particles,” consistent with the construction proposed by NanoCollect.

T. “from the fluidic stream of particles” (’263 Patent, claims 1, 14, and 19)

96. Similarly, a POSA would have understood “from the fluidic stream of particles” as used in claims 1, 14, and 19 of the ’263 patent to mean “from the stream of fluid carrying the particles.” As discussed above, the claimed devices rely on laminar flow. Laminar flow means that there are multiple parallel layers, or streams, that flow through a channel together. Thus, a particle can be removed from the stream of fluid carrying the particles without being removed from fluid altogether. The selected particle would simply end up in a different stream, or layer, within the laminar flow.

97. This is consistent with both the plain language of the claims and the prosecution histories of the ’263 patent. First, the disputed claim term includes the word “fluidic.” Particles are not fluid. Thus, the term “from the fluidic stream of particles” necessarily includes both the particles and the fluid.

98. Second, claim 1 of the ’263 patent requires an infringing device include a switching device that delivers a transient pressure pulse that “displaces and separates a selected single sensed particle from the fluidic stream of particles.” The claim recites that the *particle* is displaced, not the stream of fluid. Cytonome states even admits as much when it alleges that NanoCollect’s “understanding is contradicted by every sorting embodiment in the asserted

patents, which show that an actuator deflects the particles to alter their paths within the carrier fluid.”

99. A POSA would have understood that the stream of fluid carrying the particles is one of several streams within a laminar flow. Moreover, a POSA would also understand the term “stream of particles” to mean that several particles are in the flow channel simultaneously.

U. “selectively applying” (’528 Patent, claim 18 and ’850 Patent, claim 1)

100. The claim term “selectively applying” as recited in claim 18 of the ’528 patent and claim 1 of the ’850 patent with respect to “an actuator for selectively applying a pressure pulse” is indefinite. An “actuator” applies a pressure pulse. An actuator cannot “selectively” apply a pressure pulse. The claim term “selectively” typically applies to computers or processors that control actuators. This claim term is not commonly used with respect to the actuator itself determining when to apply a pulse.

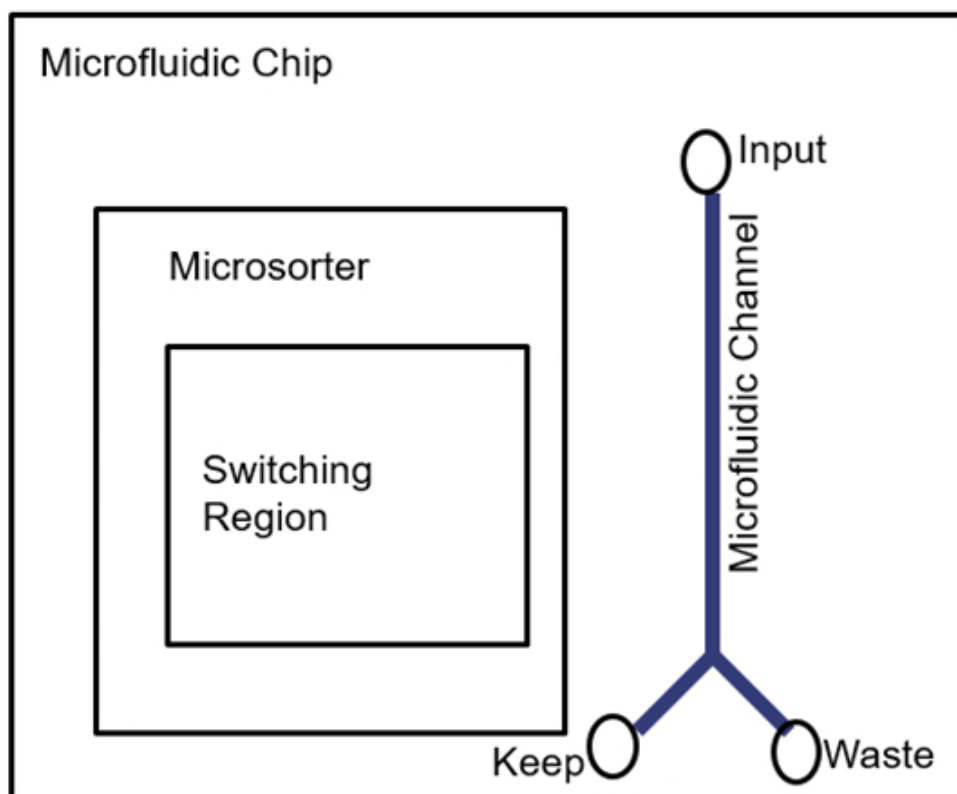
101. Further, the specification makes clear that the actuator is a standard off-the-shelf component rather than one specially adapted to “selectively apply” a pressure pulse. *See* ’528 patent at 7:23-25 (“[t]he actuator 50 may comprise any suitable device for deflecting the wall, such as an electromagnetic actuator or a piezoelectric element.”) (emphasis added). A POSA would not understand any embodiment in the ’528 or ’850 patents to include an actuator that selects when to apply a pressure pulse. Accordingly, a POSA would not understand the metes and bounds for the claim term “selectively applying.”

V. “microsorter having a switching region and a microfluidic channel formed in the microfluidic chip fluidically coupled to a sample input a keep output, a waste output, and the switching region” (’188 Patent, claim 1)

102. The term is indefinite because a POSA would not know the arrangement of the recited parts with reasonable certainty. The full element of claim 1 of the ’188 patent reads, a “particle processing assembly comprising: a microfluidic chip including at least one microsorter having a switching region and a microfluidic channel formed in the microfluidic chip fluidically coupled to a sample input a keep output, a waste output, and the switching region.” This term is

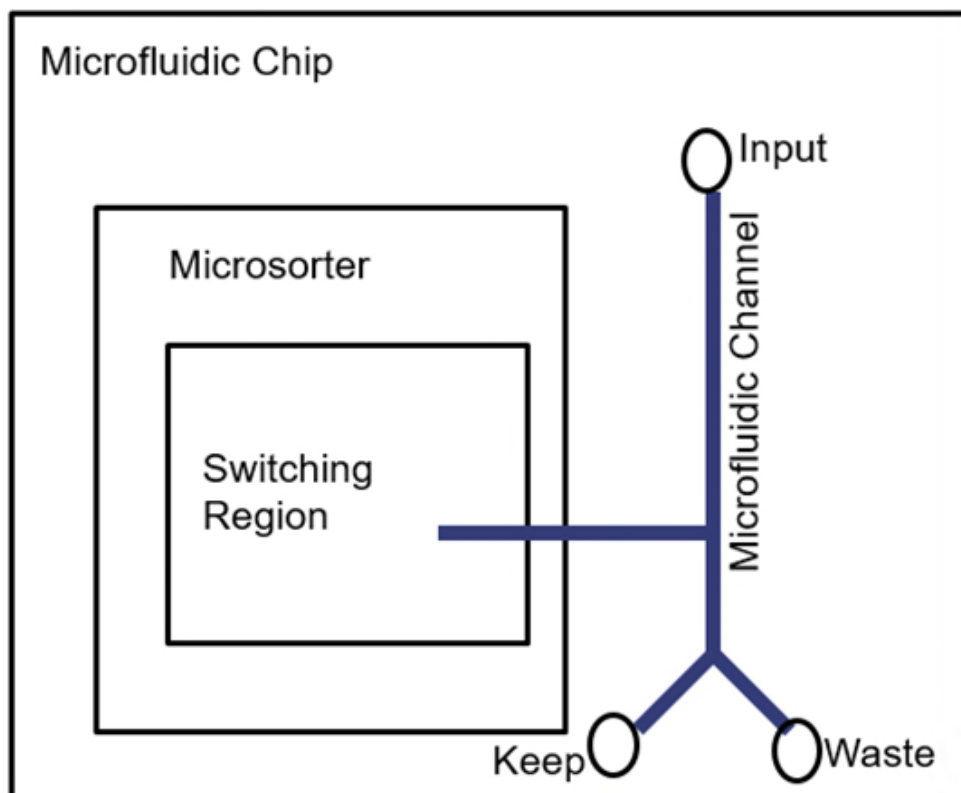
subject to multiple constructions such that a POSA cannot determine the metes and bounds of the claim.

103. In a first construction, the microfluidic chip includes at least one microsorter having a switching region. The microfluidic chip also comprises a microfluidic channel formed in the microfluidic chip coupled to a sample input, a keep output, a waste output, and the switching region. Such an arrangement would look like the following diagram:



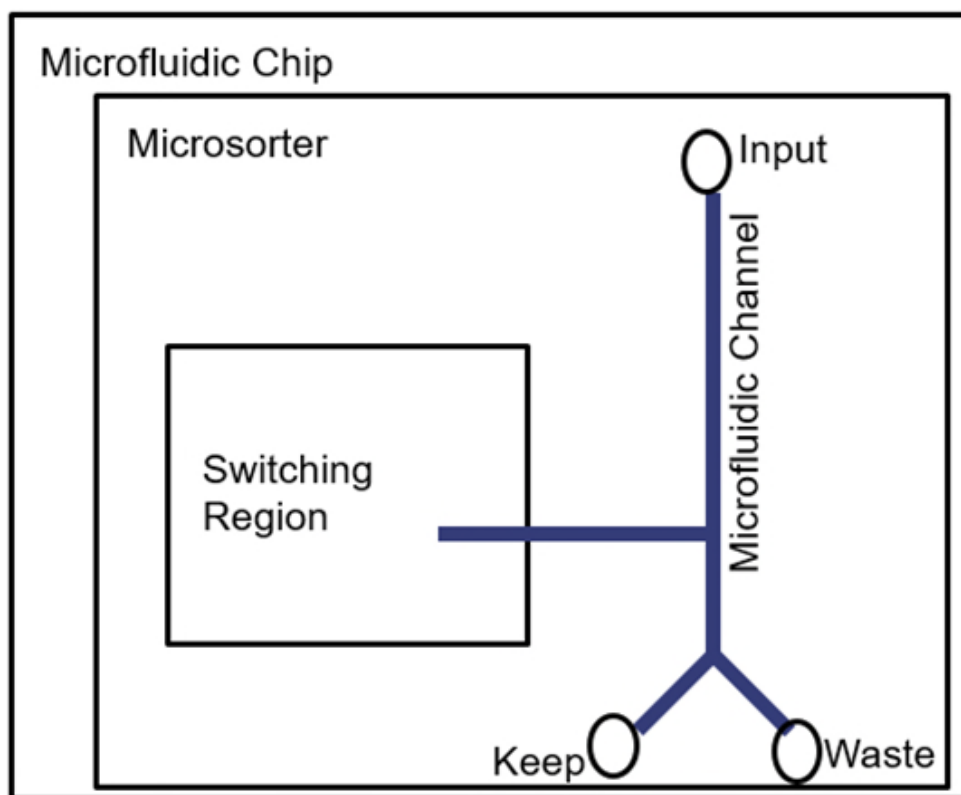
104. The claim also requires that the microfluidic channel is fluidically coupled to each of the sample input, keep output, waste output, and switching region. Each of these is a separate claimed element. The elements are presented as a list. The claim does not indicate that one of these elements comprises any of the other elements. For example, the microfluidic channel is fluidically coupled to the switching region; the microfluidic channel does not comprise the switching region. The microfluidic channel is, therefore, a separate part from the switching

region. Thus, when adding the fluidic connections, the first construction would look like the following diagram:



105. Moreover, this construction is consistent with a POSA's understanding of the term "fluidically coupled," which means that two components are in direct fluidic communication with each other. This term requires a direct connection between two components as a result of the word "coupled." Thus, two fluidically coupled components must be immediately adjacent to each other and in physical contact with each other. This is in contrast to components that are in "fluidic communication" with each other, which allows for indirect fluidic connections. It is unclear how the switching region can be fluidically coupled to the microfluidic channel if the switching region is on the microsorter and the microfluidic channel is not.

106. In a second construction, the microfluidic chip comprises the microsorter, which comprises both the switching region and the microfluidic channel structure. Such a construction would look like the following diagram:



107. This construction is consistent with the absence of a comma after the word region as compared to claim 12. *Compare* '188, claim 1 (“a microfluidic chip including at least one microsorter having a switching region and a microfluidic channel formed in the microfluidic chip fluidically coupled to a sample input a keep output, a waste output, and the switching region.”), with an analogous element in claim 12 (“a microfluidic chip including at least one microsorter having a switching region, and a microfluidic channel formed in the microfluidic chip fluidically coupled to a sample input a keep output, a waste output, and the switching region.”).

108. The absence of the comma appears to be intentional. Cytonome requested a Certificate of Correction on October 9, 2019. Cytonome fixed several commas in the claims but did not make the comma in claim 1 consistent with the comma in claim 12. As a result, a POSA

would have understood that the absence of the comma implies a different arrangement of similar elements.

109. While such a construction would include the switching region and the microfluidic channel on the microsorter, the microfluidic channel would be formed on the microsorter, not the microfluidic chip. Thus, this construction would read out the limitation that the microfluidic channel is formed on the microfluidic chip.

110. Finally, a third construction might attempt to fluidically couple the switching region with the keep output and waste output. In this construction, however, the switching region would have to be fluidically coupled to *itself*. This is because the claim term would require the switching region to be fluidically coupled to each of the items on the list, including itself: a “microsorter **having a switching region** ... fluidically coupled to a sample input, a keep output, a waste output, **and the switching region.**” What’s more such a construction would also require that each of the switching region and the microfluidic channel be fluidically coupled to each of the items on the list: “microsorter **having a switching region and a microfluidic channel** formed in the microfluidic chip fluidically coupled to **a sample input a keep output, a waste output, and the switching region.**” Such a construction would lead to a non-sensical microfluidic chip design and is, therefore, indefinite.

111. Given that the claim is unclear which of the three constructions is correct, and given that each of the constructions is indefinite, the term a “microsorter having a switching region and a microfluidic channel formed in the microfluidic chip fluidically coupled to a sample input a keep output, and a waste output, and the switching region” is indefinite.

I declare, under penalty of perjury, under the laws of the United States, that the foregoing is true and correct, and that this Declaration was completed on the 14th day of February.



Dino Di Carlo, Ph.D.

EXHIBIT 1

CURRICULUM VITAE

NAME Dino Di Carlo	POSITION TITLE Professor and Vice Chair Department of Bioengineering Professor of Mechanical Engineering Director, Cancer Nanotechnology Program Jonsson Comprehensive Cancer Center University of California, Los Angeles
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EDUCATION & TRAINING:

START MONTH/ YEAR	END MONTH/ YEAR	DEGREE (if applicable)	INSTITUTION AND LOCATION	TRAINING MENTOR	SCIENTIFIC DISCIPLINE
<u>8/06</u>	<u>7/08</u>	<u>Post Doc</u>	<u>Harvard Medical School, Massachusetts General Hospital</u>	<u>Professor Mehmet Toner</u>	<u>Center for Engineering in Medicine</u>
<u>9/02</u>	<u>5/06</u>	<u>Ph. D.</u>	<u>University of California, Berkeley and San Francisco</u>	<u>Professor Luke P. Lee</u>	<u>Bioengineering</u>
<u>9/99</u>	<u>5/02</u>	<u>B. S.</u>	<u>University of California, Berkeley</u>		<u>Bioengineering</u>

PROFESSIONAL POSITIONS:

START MONTH/ YEAR	END MONTH/ YEAR	POSITION TITLE	DEPARTMENT	INSTITUTION AND LOCATION
<u>7/16</u>	<u>present</u>	<u>Vice Chair</u>	<u>Bioengineering</u>	<u>University of California, Los Angeles</u>
<u>6/16</u>	<u>present</u>	<u>Visiting Professor</u>	<u>Chemistry</u>	<u>University of Tokyo</u>
<u>6/16</u>	<u>present</u>	<u>Professor</u>	<u>Mechanical Engineering</u>	<u>University of California, Los Angeles</u>
<u>7/15</u>	<u>present</u>	<u>Professor</u>	<u>Bioengineering</u>	<u>University of California, Los Angeles</u>
<u>7/12</u>	<u>7/15</u>	<u>Associate Professor</u>	<u>Bioengineering</u>	<u>University of California, Los Angeles</u>
<u>7/08</u>	<u>7/12</u>	<u>Assistant Professor</u>	<u>Bioengineering</u>	<u>University of California, Los Angeles</u>

ACADEMIC**Awards and Honors**

- 2016 Presidential Early Career Award for Scientists and Engineers (PECASE)
- 2016 Elected Fellow of the American Institute for Medical and Biological Engineering (AIMBE)
- 2016 Materials Research Society Outstanding Young Investigator Award
- 2015 Pioneers of Miniaturization Prize
- 2015 Elected Fellow of the Royal Society of Chemistry (FRSC)
- 2014 Analytical Chemistry Young Innovator Award
- 2012 National Science Foundation (NSF) CAREER Award

2012 Office of Naval Research (ONR) Young Investigator Award
 2011 David and Lucile Packard Fellowship in Science and Engineering
 2011 Defense Advanced Research Projects Agency (DARPA) Young Faculty Award
 2010 National Institutes of Health (NIH) Director's New Innovator Award
 2010 Wallace H. Coulter Foundation Translational Research Award
 2005 Best Poster Award – Micro Total Analysis Systems Conference, Boston MA, USA
 2001 University of California Berkeley Bioengineering Departmental Citation (*One award given annually*)
 2000 Guidant Corporation Summer Research Award
 2000 Edward Frank Kraft Prize

Fellowships

2007- 2009 American Cancer Society Postdoctoral Fellowship
 2002- 2006 Whitaker Foundation Graduate Fellowship
 2002- 2003 MESA Fellow, Sandia National Laboratories

CONSULTING AND POSITIONS

10/19 – present	Deputy Director	PATHS-UP NSF Engineering Research Center
05/17 – present	Co-Founder and Board Member	Forcyte Biotechnologies
01/15 – present	Co-Founder and Scientific Advisor	Ferrologix
03/15 – 1/17	Scientific Advisor	Omega Biosciences (acquired by BD)
11/14 – present	Co-Founder and Board Member	Tempo Therapeutics
03/13 – present	Co-Founder and Board Member	CytoVale Inc.
01/13 – present	Co-Founder and Board Member	Vortex Biosciences
01/13 – 01/17	Consultant	NetScientific
12/15 – 3/19	Director	Cancer Nanotechnology Program, JCCC, Los Angeles
09/12 – present	Member	Jonsson Comprehensive Cancer Center, Los Angeles
09/09 – present	Member	California NanoSystems Institute, Los Angeles, CA
08/09 – present	Scientific Advisor	Cue Inc.

EDITORIAL / REFEREE ACTIVITY

Editorial Board, *Lab on a Chip*

Journal Review: *Nature, Nature Nanotechnology, Nature Chemistry, Nature Communications, Nature Methods, Nature Biomedical Engineering, Nature Reviews Cellular and Molecular Biology, Advanced Materials, ACS Nano, ACS Chemical Biology, Lab on a Chip, Proceedings of the National Academy of Sciences of the USA, Nature Medicine, SLAS Technology, Biomaterials, Rheologica Acta, Biotechnology and Bioengineering, Scientific Reports, PLoS One, FEMS Letters, Electrophoresis, Journal of Biomechanics, Journal of Fluid Mechanics, Cellular and Molecular Life Sciences, Journal of Physical Chemistry Letters, Physics of Fluids, Biomicrofluidics, Chemical Communications, Soft Matter, IEEE Sensors, Physical Review Letters, Microfluidics and Nanofluidics, Review of Scientific Instruments, Biomedical Microdevices, JMEMS, Biomacromolecules, Journal of the Royal Society – Interface, Sensors and Actuators B, IEEE Transactions of Biomedical Engineering, Biotechnology Progress, Analytical Chemistry, Journal of Micromechanics and Microengineering, The Analyst.*

Grant Review: *NSF SBIR, NSF CBET, NIH IMAT, NIH NANO, NIH New Innovator Awards, Pierre Gilles De Gennes Institute, NIH - Molecular and Cellular Hematology (MCH), JSPS (Japanese Society for the Promotion of Science), NIH - Cell, Molecular, and Computational Biology IMST, TATRC West, NIH Robotics SBIR, Army Research Office, NIH Challenge Grant, National Science and Technology Program for Nanoscience and Nanotechnology (Taiwan), AAAS RCP for KACST (Saudi Arabia) Program, Swiss National Science Foundation*

CHAIRING OF CONFERENCES & SYMPOSIA

2018	Chair	IEEE EMBS Micro & Nanotechnology in Medicine Conference
2018	Co-chair	Harnessing Physical Forces for Medical Applications Symposium
2017	Co-chair	Fundamentals and Applications of Microfluidic Compartmentalization
2017	Chair	Gordon Research Conference (Physics and Chemistry of Microfluidics)
2016	Organizing Committee	Biophysical Society – Mechanobiology of Disease Meeting
2016	Chair	IEEE EMBS Micro & Nanotechnology in Medicine Conference
2016	Chair	Society for Lab Automation and Screening (5000 attendee conference)
2015	Vice Chair	Gordon Research Conference (Physics and Chemistry of Microfluidics)
2014-present	Founding Co-Chair	Southern California Micro & Nanofluidics Symposium

Service

05/14-5/17	Executive Committee	Micro Total Analysis Systems Conference
01/14	Track Chair	SLAS 2014 – Micro and Nano Devices
12/13	Symposium Chair	International Conference on Biomedical Engineering
09/13	Session Chair	Biomedical Engineering Society Meeting – Micro & Nano
09/13	Session Chair	Biomedical Engineering Society Meeting – Biomechanics
06/13	Session Chair	UC Systemwide Bioengineering Symposium
05/13	Program Committee	Micro Total Analysis Systems Conference
01/13	Track Chair	SLAS 2013 – Micro and Nano Devices
10/12	Session Chair	Biomedical Engineering Society Meeting - Diagnostics
09/12	Session Chair	International Congress of Theoretical and Applied Mechanics
05/12	Program Committee	Micro Total Analysis Systems Conference
02/12	Session Chair	SLAS 2012 – Single-Cell Analysis and Cytometry
07/11	Poster Judge	Gordon Research Conference – Phys. & Chem. of Microfluidics
06/11	Poster Judge	UC Systemwide Bioengineering Symposium
05/11	Program Committee	Micro Total Analysis Systems Conference
10/10	Session Chair	Micro Total Analysis Systems Conference – Cell Analysis II Session
06/10	Session Chair	UC Systemwide Bioengineering Symposium – Biomedical Devices Session
10/09	Session Chair	Society of Rheology, Annual Meeting – Microfluidics Session
06/09	Session Chair	UC Systemwide Bioengineering Symposium – New Frontiers

EDUCATIONAL ACTIVITIES**Course Development**

2018	Biotechnology of Cellular Therapies (BE 298)	Cell Therapies and Manufacture
2012	Fluid-Structure Fluid-Particle Interactions in Microflows (BE 255)	Fluid Mechanics Course
2009	Computational Bioengineering Design (BE 182B, 177A)	Computational Fluid Dynamics
2009	Bioengineering Design Projects (BE 182C, 177B)	Engineering Design Course
2008	Bioengineering Capstone Design (BE 182A, 167L)	Bioengineering Lab

Course Teaching

Bioengineering Capstone Design (BE 182A)	Fall 2008, Spring 2009, Fall 2009, Spring 2010,
Bioengineering Laboratory (BE 167L)	Spring 2011, Spring 2012, Spring 2013, Spring 2017
Computational Bioengineering Design (BE 182B)	Spring 2009, Fall 2009, Fall 2010
Bioengineering Design Projects (BE 182C)	Spring 2009, Winter 2010, Winter 2011
Fluid-Structure Fluid-Particle Interactions in Microflows (BE 255)	Winter 2012, Spring 2014, Spring 2015, Winter 2018
Bioengineering Capstone Design I (BE 177A)	Fall 2011, 2012, 2013, 2014, 2015
Bioengineering Capstone Design II (BE 177B)	Winter 2012, 2013, 2014, 2015, 2016
Biotechnology of Cellular Therapies (BE 298)	Winter 2018

ADVISEES: (14 Postdocs, 29 Ph.D., 4 M.S.) – Current positions include Assistant Professor Johns Hopkins, Professor University of Tokyo, Assistant Professor KAIST, Assistant Professor UC Irvine, Assistant Professor RPI, CSO Vortex Biosciences, CTO CytoVale, Scientist II Illumina, Scientist Genapsys, Scientist BD Biosciences, Adjunct Assistant Professor UCLA, CEO Tempo Therapeutics, COO Ferrologix, President Forcyte Biotechnologies

Graduate

Cayden Williamson	Ph.D.	2019-present
Felis Koo	Ph.D.	2019-present
Vishwesh Shah	Ph.D.	2018-present
Shreya Udani	Ph.D.	2018-present
Elaine Wang	Ph.D.	2018-present
Mark van Zee	Ph.D.	2018-present
Maani Archang	M.D/Ph.D.	2018-present
Hiromi Miwa	Ph.D.	2017-present
Rob DiMatteo	Ph.D.	2017-present
Yilian Wang	Ph.D.	2016-present
Joseph de Rutte	Ph.D.	2016-present

Jaekyung Koh	Ph.D.	2014-2019	Current Position: Scientist, Singular Genomics
Andy Tay	Ph.D.	2014-2017	Current Position: Lecturer, University College London
Armin Karimi	Ph.D.	2014-2018	Current Position: Senior Mechanical Engineer, Sensor-Kinesis Corp
Jonathan Lin	M.D./Ph.D.	2013-2018	Current Position: Staff Engineer, Becton Dickinson
Manjima Dhar	Ph.D.	2013-2017	Current Position: Scientist, Poseida Therapeutics
Soroush Kakhestani	Ph.D.	2013-2017	Current Position: Staff Engineer, DeepCell Inc.
Reem Khojah	Ph.D.	2013-2019	Current Position: Postdoc, UC Santa Cruz
Enrique Munoz	Ph.D.	2013-present	
Ivan Pushkarsky	Ph.D.	2013-2017	Current Position: President, Forcyte Biotechnologies
Janay Kong	Ph.D.	2012-2017	Current Position: Senior Research Scientist, NextGen Laboratories
Harsha Kittur	Ph.D.	2012-2017	Current Position: Scientist, Phase Diagnostics
Jerry Wu	Ph.D.	2012-2016	Current Position: Engineer, Azure Inc.
Keegan Owsley	Ph.D.	2012-2016	Current Position: Staff Engineer, Becton Dickinson
Oladunni Adeyiga	Ph.D.	2011-2016	Current Position: Instructor in Medicine, UCLA
James Che	Ph.D.	2012-2015	Current Position: Scientist, Vortex Biosciences
Coleman Murray	Ph.D.	2010-2015	Current Position: COO, Ferrologix
Mahdokht Masaeli	Ph.D.	2010-2013	Current Position: CEO, DeepCell
Hamed Amini	Ph.D.	2009-2012	Current Position: Scientist II, GRAIL
Westbrook Weaver	Ph.D.	2008-2013	Current Position: CEO, Tempo Therapeutics
Daniel R. Gossett	Ph.D.	2008-2012	Current Position: Program Officer, NIH
Albert Mach	Ph.D.	2008-2012	Current Position: Strategic Marketing Manager, Becton Dickinson
Henry Tse	Ph.D.	2008-2012	Current Position: CTO, Cytovale Inc.
Peter Tseng	Ph.D.	2008-2012	Current Position: Assistant Professor, University of California, Irvine
Soojung Claire Hur	Ph.D.	2008-2011	Current Position: Assistant Professor, Johns Hopkins University
Michael Bogumil	M.S.	2019-present	
Jacob Hambalek	M.S.	2019-present	
Hamed Nilchi	M.S.	2016-2019	Current Position: PhD Student, UCLA
Wei Yang	M.S.	2016-2017	Current Position: Research Associate, 10X Genomics
Derek Go	M.S.	2013-2014	Current Position: University of Cincinnati M.D. Program
Dianne Pulido	M.S.	2011-2012	Current Position: CEA Leti, France

Postdoctoral Fellows Sponsored

Ghulam Destgeer	2018-Present	Ph.D. KAIST, 2018
Daniel Stoecklein	2017-Present	Ph.D. Iowa State Univ, 2017
Kahlen Ouyang	2016-Present	Ph.D. Hong Kong Univ, 2013
Carson Riche	2016-2017	Ph.D. University of Southern California, 2015 Current Position: Engineering Lead, LabCyte Inc / Danaher
Hamed Haddadi	2014-2018	Ph.D. City University of New York, 2014 Current Position: Corning Inc.
Ming Li	2014-2017	Ph.D. University of Wollongong, Australia, 2013 Current Position: Instructor, Macquarie University
Eric Diebold	2014-2015	Ph.D. Harvard University Current Position: Vice President, Instrumentation, Becton Dickinson
Donghyuk Kim	2013-2017	Ph.D. University of Minnesota, 2013 Current Position: Postdoc, CNRS
Anja Kunze	2012-2015	Ph.D. EPFL, Switzerland, 2011 Current Position: Assistant Professor Montana State University, USA
Michael Masterman-Smith	2012-2013	Ph.D., UCLA, 2010 Current Position: Co-founder, Harmony Biosciences, Inc.
Aram Chung	2011-2013	Ph.D. Cornell University, 2011 Current Position: Associate Professor, Korea University, Seoul, South Korea
Keisuke Goda	2011-2012	Ph.D. MIT Current Position: Professor, University of Tokyo, Tokyo, JAPAN
Elodie Sollier	2010-2012	Ph.D. CEA LETI, Grenoble 2009 Current Position: CSO, Vortex Biosciences, Menlo Park, USA
Wonhee Lee	2009-2011	Ph.D. Applied Physics, Cal Tech 2008 Current Position: Associate Professor, KAIST, Daejeon, KOREA

Visiting Scholars

Matteo Antognoli	M.S.	Present
Alessandro Novello	M.S.	2018
Rishav Roy	B.S.	2015
Petra Paie'	M.S.	2015
Rogier Schoeman	M.S.	2014
Celia Fouques	B.S.	2014
Melanie Triboulet	B.S.	2013
Tiancheng Fang	B.S.	2013
Patrick Sandoz	M.S.	2011-2012
Yi Xu	B.S.	2011
Pietro Maoddi	B.S.	2011

Undergraduate

Noor Ahmed, Shivani Dharmaraja, Daniel Heikali, Tihut Kebede, Steven Behrens, Jae Hyun Kim, Andy Lee, Marc Lim, Laura Mullens, Chih Ann Yih, Erika Fong, Armin Arshi, Jaideep Dudani, Michelle Wong, Ish Talati, Derek Go, Grace Kwong, Tiffany Leung, Dewal Gupta, Viviana Ogawa, Anna Nonaka, Shayan Aftab, Yeganeh Amini, Avery Hua, Dylan Black, Margaret Phiukhao, Jessica Wong, Victor Yu, Maxwell Johnson, Lillian Peng, Andrew Jann, Mark van Zee, Alberto Escobar, Tridib Biswas, Michael Bogumil, Christina De Cesaris, Jacob Hambalek, Thomas Horn, Donghyeok Kim, Alexis Joo, Darren Lo, Michael Margolis, Sithara Menon, Simon Ng, Rose Rumyan, Andrew Eugenio, Nairi Tahmizyan, Trevor Burnes, Brian Cheng, Kayla Choi, Mireya Cervantes, Ana Gu, Angela Lu, Ella Pachler, Jaikin Patel, Jenny Sun

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51. Di Carlo, Dino; Ouyang, Mengxing. Inventors; Regents of the University of California, assignee. Provisional Application Filed (62/689,455).

50. Di Carlo, Dino; Damoiseaux, Robert; Li, Ming; van Zee, Mark. Inventors; Regents of the University of California, Assignee. Provisional Application Filed (62/634,562).

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47. Di Carlo D, Wu CY. inventors; Regents of the University of California, assignee. Provisional Application Filed (62/463,272).

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PRESENTATIONS (>30 oral presentations at meetings, 114 invited talks, 11 keynote and plenary lectures)

Invited Talks

126. **Di Carlo D**. Quantum Diagnostics: From Single-Cells to Single-Molecules. Microfluidics & Organ-on-a-Chip Asia meeting. Narita, JAPAN. 11/15/2019.
125. **Di Carlo D**. Lab-on-a-particle technologies for function-based cytometry and cell sorting. Global Serendipity Lab Symposium. Tokyo, JAPAN. 11/10/2019.
124. **Di Carlo D**. Quantum Diagnostics: From Single-Cells to Single-Molecules. Lab on a Chip & Microfluidics World Congress. San Diego CA, USA. 10/9/2019.
123. **Di Carlo D**. Lab-on-a-particle technologies based on armored emulsions. The 16th U.S.-Korea Forum on Nanotechnology. La Jolla CA, USA. 8/23/2019.
122. **Di Carlo D**. Commercialization of Bioengineering Technologies from UCLA. Masason Foundation Scholars. Los Angeles CA, USA. 8/25/2019.
121. **Di Carlo D**. Rapid Sepsis Diagnosis with Deformability Cytometry. Sepsis – Novel Biomarkers, Technology, and Predictive Analytics Session (AACC). AACC Annual Meeting. Anaheim CA, USA. 8/5/2019.

120. **Di Carlo D.** Quantum Diagnostics – From Single Cells to Single Molecules. Micro- and Nanotechnologies for Medicine Workshop. Los Angeles CA, USA. 7/9/2019.
119. **Di Carlo D.** Keynote Presentation: Quantum Diagnostics: From Single-Cells to Single-Molecules. Labroots Webinar. <https://www.labroots.com/webinar/keynote-presentation-quantum-diagnostics-single-cells-single-molecules>. 5/30/2019.
118. **Di Carlo D.** Lab-on-a-particle technologies based on armoured emulsion. Lab on a Chip Symposium – from fundamentals to applications. London, UK. 5/21/2019.
117. **Di Carlo D.** Quantum Diagnostics: from single cells to single molecules. Bioengineering Seminar Series, University of Southampton. Southampton, UK. 5/20/2019.
116. **Di Carlo D.** Quantum Diagnostics: from single cells to single molecules. Physics and Astronomy Colloquium. Los Angeles CA, USA. 5/16/2019.
115. **Di Carlo D.** Quantum Diagnostics: from single-cells to single-molecules. Caltech Chemical Engineering Seminar. Pasadena CA, USA. 5/2/2019.
114. **Di Carlo D.** Quantum Diagnostics and Ubiquitous Health Sensors. Science and Technology in Society Forum (STS Forum). Kyoto, JAPAN. 10/8/2018.
113. **Di Carlo D.** Novel Devices for Sepsis. Interdisciplinary Sepsis Symposium. Chicago IL, USA. 9/11/2018.
112. **Di Carlo D.** Quantum Diagnostics: from single-cells to single-molecules. ASME Nanoengineering in Medicine and Biology meeting. Los Angeles CA, USA. 8/21/2018.
111. **Di Carlo D.** Phenotypic Liquid Biopsies. Gordon Research Conference: Liquid Biopsy for Cancer. Mount Holyoke College, South Hadley MA, USA. 8/6/2018.
110. **Di Carlo D.** Physical Phenotyping of Cells for Diagnostics and Drug Discovery. Mechbio conference: The Mechanome in Action. University of California Irvine, Irvine CA, USA. 7/26/2018.
109. **Di Carlo D.** Physical Phenotyping of Cells. Zasshikai seminar 1742nd. University of Tokyo, Tokyo, JAPAN. 7/9/2018.
108. **Di Carlo D.** Quantum Diagnostics – from Single cells to Single molecules. 212th iCeMS Seminar. Kyoto University. Kyoto, JAPAN. 4/3/2018.
107. **Di Carlo D.** Quantum Diagnostics – from Single cells to Single molecules. Medicine and Technology in the 21st Century: Future Perspective. UCLA-Japan Center. Nihombashi Life Science Building. Tokyo, JAPAN. 3/31/2018.
106. **Di Carlo D.** Physical Phenotyping of Cells. Broad Stem Cell Research Symposium. UCLA. Los Angeles, CA, USA. 2/2/2018.
105. **Di Carlo D.** Microfluidic Microstructured Materials. Simons X Mathematical Nanosystems Symposium. UCLA. Los Angeles, CA, USA. 1/18/2018.
104. **Di Carlo D.** High-throughput force biology. Cardiovascular Theme Seminar Series. UCLA. Los Angeles, CA, USA. 12/11/2017.
103. **Di Carlo D.** Microfluidic Microstructured Materials. Center for Biomolecular and Tissue Engineering Seminar Series. Duke University. Durham, NC, USA. 11/30/2017.
102. **Di Carlo D. Keynote Presentation:** Micro & Nanotechnologies for Physical Phenotyping of Cells. Lab-on-a-chip World Congress. Coronado Island/San Diego, CA, USA. 10/2/2017.
101. **Di Carlo D.** Microfluidic Cell Sorting and Analysis. BD Biosciences Seminar. Becton Dickinson, San Jose, CA, USA. 9/29/2017.

100. **Di Carlo D.** Physical Phenotyping of Cancer. NCI MCL Consortium Steering Committee Meeting. Luskin Center. Los Angeles CA, USA. 9/28/2017.
99. **Di Carlo D.** Micro and Nanotechnologies for Directed Evolution of Cell Therapies. Serendipity Seminar Series. University of Tokyo, Tokyo, JAPAN. 6/23/2017.
98. **Di Carlo D.** Integrated microfluidic systems for analyzing single entities. Fundamentals and Applications of Microfluidic Compartmentalization Workshop. Okinawa Institute of Science and Technology. Onna-san, Okinawa, JAPAN. 6/14/2017.
97. **Di Carlo D.** Putting the Squeeze on Cells to Diagnose Disease. Our Lady of the Lake Baton Rouge Grand Rounds. Baton Rouge, LA, USA. 5/24/2017.
96. **Di Carlo D.** Nano-magnetic Manipulation of Cells. TANMS Seminar. University of California Los Angeles, Los Angeles, CA, USA. 5/12/2017.
95. **Di Carlo D.** Putting the Squeeze on Cells to Diagnose Disease. BioBasics Layman Seminar Series. University of California, Los Angeles, Los Angeles, CA, USA. 3/22/2017.
94. **Di Carlo D.** Physical Phenotyping. Berkeley Bioengineering Seminar Series. University of California Berkeley, Berkeley, CA, USA. 3/15/2017.
93. **Di Carlo D.** Single-Cell Phenotypic Analysis of Circulating Tumor Cells. Molecular Medicine Tri-con Meeting. San Francisco, CA, USA. 2/21/2017.
92. **Di Carlo D.** Physical and Functional Analysis of Single Circulating Tumor Cells. Jonsson Comprehensive Cancer Center Seminar. Los Angeles, CA, USA. 11/16/2016.
91. **Di Carlo D.** Biophysical Cytometry. EPFL Bioengineering Seminar Series. Lasaunne, SWITZERLAND. 10/17/2016.
90. **Di Carlo D.** The Physics of Life at the Microscale. Packard Fellows Annual Meeting. Monterey CA, USA. 9/9/2016.
89. **Di Carlo D. Keynote Presentation:** Microfluidic Biotechnology. Southern California Micro & Nanofluidics Symposium. Irvine CA, USA. 9/1/2016.
88. **Di Carlo D.** Nano-magnetic Manipulation of Cells. University of California San Diego. Nanoengineering Department. La Jolla, CA. 7/21/2016.
87. **Di Carlo D.** Microstructured Materials. Okinawa Institute of Science and Technology (OIST), Okinawa, JAPAN. 6/30/2016.
86. **Di Carlo D. Keynote Presentation:** Biophysical Cytometry. CYTO 2016. Seattle, WA. 6/13/2016.
85. **Di Carlo D. Keynote Presentation:** Physical Phenotyping. Ontario-on-a-Chip Meeting. Toronto, ON, CANADA. 5/26/2016.
84. **Di Carlo D.** Commercializing Microfluidic Technologies. University of California, Santa Barbara. Center for Bioengineering. Goleta, CA. 5/23/2016.
83. **Di Carlo D.** Microstructured Materials. University of California, Santa Barbara. Mechanical Engineering Seminar Series. Goleta, CA. 5/23/2016.
82. **Di Carlo D.** Physical Phenotyping. University of California, Irvine. Bioengineering Seminar Series. Irvine CA. 4/25/2016.
81. **Di Carlo D.** Physical Phenotyping. University of Southern California. Biomedical Engineering Seminar Series. Los Angeles, CA. 4/22/2016.
80. **Di Carlo D.** Physical Phenotyping. Brown University. Bioengineering Seminar Series. Providence, RI. 4/7/2016.

79. **Di Carlo D.** Microtechnology in Medicine. LABiomed Science Friday Seminar. Torrance, CA. 2/29/2016.
78. **Di Carlo D.** Microtechnology in Medicine. UCSD Bioengineering Seminar Series. San Diego, CA. 01/28/2016.
77. **Di Carlo D.** Microtechnology in Medicine. UCLA Northern California Engineering Alumni Meeting. Atherton, CA. 11/19/2015.
76. **Di Carlo D.** Pioneers of Miniaturization Lectureship. Microfluidic Frontiers. Gyeongju, S KOREA. 10/27/2015.
75. **Di Carlo D.** Commercializing Microfluidic Cellular Analysis. Novozymes. San Francisco, CA. 10/22/2015.
74. **Di Carlo D.** Commercializing Microfluidic Cellular Analysis. Illumina. San Francisco, CA. 8/14/2015.
73. **Di Carlo D. Keynote Presentation:** Technopreneurship: Looking beyond the ivory tower. Bioentrepreneurship Summit. Biotech Connection LA. Los Angeles, CA. 6/27/2015.
72. **Di Carlo D.** Physical Phenotyping of Cells. Re-engineering BioMed Engineering Symposium. Hong Kong. Hong Kong Science Park. 5/15/2015.
71. **Di Carlo D. Keynote Presentation:** High-throughput physical phenotyping of cells for biomedicine. Lab-on-a-Chip European Congress. Berlin, GERMANY. 3/18/2015.
70. **Di Carlo D.** Vortex trapping and label-free analysis of large circulating cells. Circulate – Non Invasive Cancer Diagnostics Meeting. Berlin, GERMANY. 3/17/2015.
69. **Di Carlo D.** Vortex technology for CTC collection and automated image cytometry for CTC detection. 5th Annual Circulating Tumor Cells and Cell-Free DNA conference (Tri-con). San Francisco, CA, USA. 2/17/2015.
68. **Di Carlo D.** Physical Phenotyping. Molecular Engineering & Sciences Institute Seminar Series. University of Washington, Seattle, WA, USA. 1/27/2015.
67. **Di Carlo D.** Physical forces in the colonization and clearance of biofilms. I3T Seminar Series – Immunology, Infection, Inflammation, and Transplantation, University of California, Los Angeles, CA, USA. 5/12/2015.
66. **Di Carlo D.** Taming Cell Physics for Medicine. EMBS Micro and Nanotechnology in Medicine Conference, Oahu, HI, USA. 12/10/2014.
65. **Di Carlo D.** Inertial microfluidics for cell separation and analysis. Biomedical Engineering Seminar Series, Tulane University, New Orleans, LA, USA. 11/6/2014.
64. **Di Carlo D.** Analytical Chemistry Young Innovator Award Presentation. The 18th International Conference on Miniaturized Systems for Chemistry and Life Sciences, San Antonio, TX, USA. 10/28/2014.
63. **Di Carlo D.** Inertial microfluidics workshop. The 18th International Conference on Miniaturized Systems for Chemistry and Life Sciences, San Antonio, TX, USA. 10/26/2014.
62. **Di Carlo D.** Measuring cell mechanics for medicine. 5th Annual Physics of Cancer Symposium, Leipzig, GERMANY. 10/5/2014.
61. **Di Carlo D.** Exploiting Cell Physics for Medicine. USC Eli and Edythe Broad Stem Cell Research Seminar. Los Angeles, CA, USA. 9/16/2014.
60. **Di Carlo D.** Cell mechanical measurements for cancer diagnostics. NCI Workshop: Prospective Outlook of Mechanics in Oncology. Rockville, MD, USA. 9/11/2014.
59. **Di Carlo D.** Multiparameter mechanical and morphological phenotyping of stem cells. World Congress of Biomechanics. Boston, MA, USA. 7/8/2014.

58. **Di Carlo D.** Deformability Cytometry: Hydrodynamic Stretching of Heterogenous Cellular Samples in Microflows. World Congress of Biomechanics. Boston, MA, USA. 7/6/2014.
57. **Di Carlo D.** Inertial microfluidic manipulation and measurement of cancer cells. International Symposium on Nanotechnology-enabled Cancer Theranostics. Beijing, CHINA. 5/17/2014.
56. **Di Carlo D. Keynote Presentation:** Sculpting flow streams and manufacturing complex particles using inertial fluid physics. MRS Spring Meeting. San Francisco, CA, USA. 4/22/2014.
55. **Di Carlo D. Keynote Presentation:** Nanoengineering of Intracellular Environments. IEEE NEMS. Waikiki, HI, USA. 4/14/2014.
54. **Di Carlo D.** High-throughput cell control and analysis using inertial fluid physics. UCSB Center for Bioengineering Seminar Series. Santa Barbara, CA, USA. 4/3/2014
53. **Di Carlo D.** Measuring Cell Mechanics for Medicine. JCCC Research Seminar. Los Angeles, CA, USA. 3/20/2014
52. **Di Carlo D.** Arrayed Nanoscale Cell Stimulation and Analysis. PITTCON. Chicago, IL, USA. 3/2/2014.
51. **Di Carlo D.** Measuring Cell Mechanics for Medicine. ASME NEMB. San Francisco, CA, USA. 2/3/2014.
50. **Di Carlo D. Keynote Presentation:** Manipulating and Measuring Cell Mechanics for Medicine. Micro and Nanofluidics for Biomedical Applications Symposium Speaker – ICBME 2013, SINGAPORE. 12/4/2013.
49. **Di Carlo D.** Manipulating Cells and Measuring Biomechanics for Medicine. Mechanobiology Institute Seminar Series, National University of Singapore, SINGAPORE. 12/3/2013.
48. **Di Carlo D.** High-throughput cell control and analysis using inertial fluid physics. BiNEL seminar, Seoul National University, Seoul, KOREA. 12/2/2013.
47. **Di Carlo D.** Manipulating and Measuring Cell Mechanics for Medicine. Mechanical Engineering Seminar Series, Seoul National University, Seoul, KOREA. 11/29/2013.
46. **Di Carlo D.** High-throughput cell control and analysis using inertial fluid physics. The 1499th Zasshikai Seminar, University of Tokyo, Tokyo, JAPAN. 11/28/2013.
45. **Di Carlo D. Keynote Presentation:** Taming Inertial Fluid Physics for Advanced Diagnostics. Nanobiotech Montreaux. Montreaux, SWITZERLAND. 11/18/2013.
44. **Di Carlo D.** Manipulating and Measuring Cell Mechanics for Medicine. Bioengineering Seminar Series. University of Pennsylvania. Philadelphia, PA. 11/7/2013.
43. **Di Carlo D.** Squeezing Cells for Information to Diagnose Disease. UCLA Parent's Weekend Presentation. University of California, Los Angeles. Los Angeles, CA. 11/1/2013.
42. **Di Carlo D.** Measuring Cell Mechanics for Medicine. JCCC Research Seminar, University of California, Los Angeles. Los Angeles, CA. 10/17/2013.
41. **Di Carlo D.** Microfluidic mechano-phenotyping of stem cells. Broad Center of Regenerative Medicine and Stem Cell Research Working Group. University of California, Los Angeles, Los Angeles, CA. 8/28/2013.
40. **Di Carlo D.** Sculpting fluid flow using sequences of microstructures. Gordon Research Conference. Barga, Italy. 6/9/2013
39. **Di Carlo D. Keynote Presentation:** Taming Inertial Fluid Physics for Improved Diagnostics. Gordon Research Seminar. Barga, Italy. 6/8/2013
38. **Di Carlo D.** High-throughput mechanical characterization of cell state and function. DARPA Dialysis-like-Therapeutics Meeting. San Diego, CA, USA. 4/3/2013.

37. **Di Carlo D.** Nano-engineering of Intracellular Environments. UCLA-Japan Nano-Bio Symposium. Los Angeles, CA, USA. 3/25/2013.
36. **Di Carlo D.** Manipulating and Measuring Cell Mechanics for Medicine. University of Southern California, Physical Sciences of Oncology Center Seminar. Los Angeles, CA. 3/22/2013
35. **Di Carlo D.** Single-cell mechanophenotyping. Emerging Technologies in Cancer Research: Imaging and Diagnostics. Beverly, MA, USA. 3/4/2013.
34. **Di Carlo D.** Commercializing microfluidic cell-based assays. Licensing Executives Society Meeting. La Jolla, CA, USA. 2/12/2013
33. **Di Carlo D.** High-throughput single-cell mechanophenotyping. American Society for Cell Biology (ASCB) Annual Meeting. San Francisco, CA, USA. 12/15/2012.
32. **Di Carlo D.** EMBS Micro and Nanotechnology in Medicine: Translating technology from the bench to the bedside. Maui, HI, USA. 12/4/2012.
31. **Di Carlo D.** Measuring Cell Mechanics for Medicine. Mechanical Engineering Seminar Series. UCLA, Los Angeles, CA, USA. 10/5/2012.
30. **Di Carlo D.** Measuring Cell Mechanics for Medicine. Nagoya University-UCLA International Symposium on Micro/Nano Mechatronics for Future Biomedicine. Sapporo, Hokkaido, JAPAN. 9/21/2012.
29. **Di Carlo D.** Inertial microfluidics for high-throughput cell manipulation and analysis. Naval Research Laboratories. Bethesda, MD, USA. 9/14/2012.
28. **Di Carlo D.** Measuring Cell Mechanics for Medicine. David and Lucile Packard Fellows Retreat. Monterey CA, USA. 9/6/2012.
27. **Di Carlo D.** Measuring Cell Mechanics for Medicine. University of Tokyo - UCLA Joint Research Institute Seminar. University of Tokyo. Tokyo, JAPAN. 8/25/2012.
26. **Di Carlo D.** Measuring Cell Mechanics for Medicine. Chinese Academy of Sciences State Key Transducers Lab. Beijing, CHINA, 8/22/2012.
25. **Di Carlo D. *Introductory Lecture.*** Inertial Microfluidics: High-throughput cell and particle manipulation. ICTAM2012. Beijing, CHINA. 8/20/2012.
24. **Di Carlo D.** High-throughput cell control and analysis using inertial fluid physics. Chemical Engineering Seminar Series. California Institute of Technology, Pasadena, CA. USA. 5/17/2012.
23. **Di Carlo D.** Inertial microfluidics for high-throughput cell manipulation and analysis. Mechanical Engineering Seminar Series. Princeton University, Princeton, NJ. USA. 3/16/2012.
22. **Di Carlo D.** Inertial Microfluidics: High-throughput cell manipulation and analysis. BME Young Innovators Seminar Series. Georgia Tech. Atlanta, GA, USA. 1/31/2012.
21. **Di Carlo D.** Inertial Microfluidics: High-throughput cell manipulation and analysis. Biomedical Engineering Seminar Series. University of Southern California, Los Angeles, CA. USA. 1/9/2012.
20. **Di Carlo D.** Inertial Microfluidics: High-throughput cell manipulation and analysis. Mechanical Engineering Seminar Series. Iowa State, Ames, IA. USA. 11/15/2011.
19. **Di Carlo D.** Inertial Microfluidics: High-throughput cell manipulation and analysis. MIT Micro/Nano Seminar Series. Massachusetts Institute of Technology. Cambridge, MA, USA. 10/12/2011.

18. **Di Carlo D.** Deformability Cytometry: Clinical Applications of a Mechanical Biomarker. Koch Institute for Integrative Cancer Research Seminar Series – Massachusetts Institute of Technology. Cambridge, MA, USA. 10/11/2011.
17. **Di Carlo D.** Inertial Microfluidics: High-throughput cell manipulation and analysis. UCSB Soh Group Seminar. Santa Barbara, CA, USA. 8/12/2011.
16. **Di Carlo D.** Inertial Microfluidics. Gordon Research Conference: Physics and Chemistry of Microfluidics. Waterville Valley, NH, USA. 6/29/2011.
15. **Di Carlo D. Plenary:** Inertial effects in microfluidic systems for size and deformability-based separations. Field-flow fractionation (FFF) Symposium. South San Francisco, CA, USA. 5/25/2011.
14. **Di Carlo D.** Inertial Focusing, Ordering, and Separation of Particles in Confined Flows. SIAM Dynamical Systems Conferences. Snowbird, UT, USA. 5/23/2011.
13. **Di Carlo D.** Inertial Microfluidics: Continuous Cell Manipulation and Biomechanical Characterization at the Microscale. BD Biosciences, San Jose, CA, USA. 1/18/2011.
12. **Di Carlo D.** Inertial Microfluidics: Continuous Cell Manipulation and Biomechanical Characterization at the Microscale. Chemical Engineering Seminar Series. Virginia Tech, Blacksburg, VA, USA. 11/17/2010.
11. **Di Carlo D.** Inertial Microfluidics: High-throughput cell manipulation and analysis. University of California, Riverside. Riverside, CA. 10/27/2010.
10. **Di Carlo D.** Inertial microfluidics for flow cytometry. SPIE Optics and Photonics Meeting. San Diego, CA, USA. 8/02/2010.
9. Tseng P, Judy JW, **Di Carlo D.** Dynamic manipulation and precision localization of nanoparticles internal to cells. ASME 2010 First Global Congress on NanoEngineering for Medicine and Biology; Houston, TX, USA. 2/08/2010.
8. **Di Carlo D.** Inertial Microfluidics. LifeChip Seminar Series, University of California, Irvine. Irvine, CA. 1/22/2010.
7. **Di Carlo D.** Inertial Microfluidics - Continuous Cell Manipulation and Biomechanical Characterization at the Microscale. Penner Biomechanics Seminar, University of California, San Diego. La Jolla, CA. 12/2/2009.
6. **Di Carlo D.** Inertial microfluidics: Continuous Cell and Particle Manipulation at the Microscale. Nagoya University-UCLA International Symposium on Micro/Nano Mechatronics for Future Biomedicine. Waikoloa, HI, 9/7/2009.
5. **Di Carlo D.** Inertial microfluidics. Center for Engineering in Medicine Seminar Series, Harvard Medical School, Charlestown, MA, 5/7/2009
4. **Di Carlo D.** Inertial microfluidics. California NanoSystems Institute Seminar Series, University of California, Santa Barbara, 3/6/2009
3. **Di Carlo D.** Microscale tools for quantitative biology. Department of Bioengineering Seminar Series, UCLA, 9/25/2008
2. **Di Carlo D.** Towards microfluidic quantitative cell biology. Bioengineering, Rice University, 4/10/2008
1. **Di Carlo D.** Towards microfluidic quantitative cell biology. UCLA Bioengineering, 2/4/2008

Selected Oral Presentations at Meetings

31. **Murray C,** Tseng P, Di Carlo D. Massively Parallel Nanoparticle Manipulation with Micro-magnetic Ratcheting System for Biological Exploration. Society for Laboratory Automation and Screening. January 14th, Orlando FL, USA; 2013.

30. **Masterman-Smith M**, Tse HTK, Gossett DR, Di Carlo D. Label-free Biomechanical Single Cell Microfluidic Analysis of Cancer Stem Cells Derived from Patient Brain Tumors. Biomedical Engineering Society Annual Meeting. October 24-27, Atlanta, GA, USA; 2012.
29. **Masaeli M**, Tse HTK, Gossett DR, Clark AT, Di Carlo D. Deformability Cytometry, a Label-free Assay of Stem Cell Pluripotency. Biomedical Engineering Society Annual Meeting. October 24-27, Atlanta, GA, USA; 2012.
28. **Weaver WM**, Milisavljevic V, Miller JF, Di Carlo D. Inducing *S. epidermidis* Biofilm Formation by Fluid Forces Using a Microfluidic Shear Array. Biomedical Engineering Society Annual Meeting. October 24-27, Atlanta, GA, USA; 2012.
27. **Che J**, Mach AJ, Go DE, Talati I, Kulkarni R, Rao JY, Di Carlo D. Microfluidic Sample Preparation of Pleural Effusions for Cytodiagnosics. BMES Annual Meeting. October 24-27, Atlanta, GA, USA; 2012.
26. **Chung AJ**, Pulido D, Masaeli M, Amini H, Di Carlo D. Low pressure inertial focusing in large-scale microchannels for high-throughput flow cytometry. Biomedical Engineering Society Annual Meeting. October 24-27, Atlanta, GA, USA; 2012.
25. **Gossett DR**, Tse HTK, Goda K, Adeyiga O, Woods TA, Graves SW, Yang OO, Di Carlo D. Leukocyte mechanophenotyping by deformability cytometry. In: 16th International Conference on Miniaturized Systems for Chemistry and Life Sciences. November 1st; Okinawa, JAPAN; 2012.
24. Amini H, Masaeli M, Sollier E, Xie Y, Ganapathysubramanian B, Stone HA, **Di Carlo D**. Engineering flow cross-section via programmed pillars. In: 16th International Conference on Miniaturized Systems for Chemistry and Life Sciences. October 29th; Okinawa, JAPAN; 2012.
23. **Tse H**, Gossett D, Oliva I, Ying Y, Natarajan N, Rao JY, **Di Carlo D**. Enhancing diagnosis of pleural effusions using high-throughput deformability cytometry. American Society of Cytopathology Annual Meeting. November; Las Vegas, NV; 2012. doi:10.1016/j.jasc.2012.08.015
22. **Chung A**, Pulido D, Oka J, Masaeli M, Amini H, **Di Carlo D**. Single-stream inertial focusing of microparticles across laminar streamlines through geometry-induced secondary flows. American Physical Society – Division of Fluid Dynamics Annual Meeting. November 20th; San Diego, CA; 2012.
21. **Amini H**, Masaeli M, Sollier E, Xie Y, Ganapathysubramanian B, Stone HA, Di Carlo D. The use of sequences of pillars to engineer fluid cross-sectional shape via inertial flow deformations. American Physical Society – Division of Fluid Dynamics Annual Meeting. November 18th; San Diego, CA; 2012.
20. **Amini H**, Masaeli M, Stone HA, Di Carlo D. Programming Fluid Flow with Microstructures. American Physical Society – Division of Fluid Dynamics Annual Meeting. November 20th; Baltimore, MD, USA; 2011.
19. **Tse HTK**, Gossett DR, Lee A, Ellison A, Ying Y, Kulkarni R, Rao J, Di Carlo D. Deformability cytometry: Applications in clinical cancer diagnostics. In: 15th International Conference on Miniaturized Systems for Chemistry and Life Sciences. October 3rd; Seattle, WA, USA; 2011.
18. **Gossett DR**, Tse HTK, Dudani J, Di Carlo D. High-throughput cellular sample preparation via ultrafast solution exchange. In: 15th International Conference on Miniaturized Systems for Chemistry and Life Sciences. October 5th; Seattle, WA, USA; 2011.
17. **Di Carlo D**. Deformability Cytometry: High-throughput Label-free Measurement of Cancer Cell Malignancy and Stem Cell Differentiation State. In: LabAutomation 2011. February 1st, Palm Springs, CA, USA; 2011.
16. **Tseng P**, Judy JW, Di Carlo D. Massively Parallel, High Force Interrogation Of Single Cell Mechanics Via Localized Magnetic Nanoparticles. In: 14th International Conference on Miniaturized Systems for Chemistry and Life Sciences. October 6th; Groningen, The Netherlands; 2010.
15. **Gossett DR**, Tse HTK, Lee S, Clark AT, Di Carlo D. Deformability Cytometry: High-Throughput, Continuous Measurement Of Cell Mechanical Properties In Extensional Flow. In: 14th International Conference on Miniaturized Systems for Chemistry and Life Sciences. October 6th; Groningen, The Netherlands; 2010.

14. **Tse HTK**, Gossett DR, Lee S, Clark AT, Di Carlo D. A Novel, High-throughput, Single-cell Deformability Measurement Technique for Diagnostics and Therapeutics. In: The 2010 Biomedical Engineering Society Conference, Austin, TX, October 7th 2010.
13. **Amini H**, Sollier E, Di Carlo D. Simple Particle-Induced Transverse Mass Transport at High Flow Rates. In: The 2010 Biomedical Engineering Society Conference, Austin, TX, October 7th 2010.
12. **Amini H**, Di Carlo D. Enhancement of Micro-Mixing Utilizing Inertial Flows Around Microspheres in Channel Flow. In: 16th US National Congress of Theoretical and Applied Mechanics 2010. June 19; State College, PA, USA; 2010.
11. **Hur SC**, Di Carlo D. High Frequency Deformability Activated Cell Enrichment Using Inertial Microfluidics. In: 16th US National Congress of Theoretical and Applied Mechanics 2010. June 18; State College, PA, USA; 2010.
10. Hur SC, **Di Carlo D**. Feasibility Study of a Deformability-Activated Cell Sorting Microfluidic Platform. In: Society of Rheology Annual Meeting 2009. Oct 19; Madison, WI, USA; 2009.
9. **Hur SC**, Di Carlo D. Evaluation of High-Throughput Cell Sorting Based on Deformability in a Microfluidic System. The 2009 Biomedical Engineering Society Conference, Pittsburgh, PA, October 7-10, 2009.
8. **Gossett DR**, Di Carlo D. Critical Factors for Inertial Focusing at High Reynolds Number. The 2009 Biomedical Engineering Society Conference, Pittsburgh, PA, October 7-10, 2009.
7. **Di Carlo D**, Irimia D, Tompkins RG, Toner M. Inertial microfluidics: High-throughput focusing and separation of cells and particles. In: **MicroTAS 2008**. The 12th International Conference on Miniaturized Systems for Chemistry and Life Sciences; 2008 Oct 12-16; San Diego, CA, USA; 2008.
6. **Di Carlo D**, Edd JF, Irimia D, Toner M. Inertial microfluidics: controlled streaming particle "lattices". The 2008 Biomedical Engineering Society Conference, St. Louis, MO, October 2-4, 2008.
5. **Di Carlo D**, Irimia D, Toner M. Inertial Microfluidics For Continuous Particle Ordering. The 2007 Biomedical Engineering Society Conference, September 26-29th, Los Angeles, CA,
4. **Di Carlo D**, Aghdam N, Wu LY, Lee LP. Single-cell arrays for quantitative biology. The 2006 Biomedical Engineering Society Conference, Chicago, IL, October 11-14, 2006.
3. Zhang MY, **Di Carlo D**, Wu LY, Lee SM, White PF, Mofrad MRK, Lee LP. Self assembly of hepatocyte spheroids on a chip. The 2006 Biomedical Engineering Society Conference, Chicago, IL, October 11-14, 2006.
2. **Di Carlo D**, Aghdam N, Lee LP. Hydrodynamic trapping arrays for large scale single-cell analysis. The 2005 Biophysical Society Meeting, Salt Lake City, UT, February 18-22, 2005
1. **Di Carlo D**, Ionescu-Zanetti C, Zhang Y, Hung P, Lee LP. On-Chip Cell Lysis by Reagent Synthesis from the Working Fluid. In: **MicroTAS 2004**. The 8th International Conference on Miniaturized Systems for Chemistry and Life Sciences; 2004 Sept 26-30; Malmo, Sweden; 2004. p. 165-167.

PROFESSIONAL SOCIETIES

Materials Research Society, Royal Society of Chemistry, SPIE, Society for Laboratory Automation and Screening, Society of Rheology, Biomedical Engineering Society, American Chemical Society, Biophysical Society, AAAS.

ACTIVE GRANTS

Project Title: Training the Next Generation of Leaders in Biomedical Engineering Design

Source of Support: NIH/NIBIB

Award Number: 1R25EB027626-01

Total Award Period Covered: 6/15/19-2/29/24

PI: Dino Di Carlo

Funding: \$21,600

Project Title: Neural Modulation

Source of Support: GE Global Research

Total Award Period Covered: 3/1/19-3/31/20

PI: Dino Di Carlo

Funding: \$51,724

Award Number: 401121353

Project Title: Engineering Research Center for Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP)

Source of Support: NSF

Total Award Period Covered: 10/1/17-9/30/22

Co-I: Dino Di Carlo (Site PI Aydogan Ozcan)

Funding: \$995,735

Award Number: 1648451

Project Title: NSF nanosystems engineering research center for translational applications of nanoscale multiferroic systems

Source of Support: NSF

Total Award Period Covered: 9/1/2017-8/31/22

PI: Greg Carman, **Co-I:** Dino Di Carlo

Funding: \$434,900.79

Award Number: 1160504

Project Title: Portable Lyme disease Diagnostics

Source of Support: Steven and Alexandra Cohen foundation

Total Award Period Covered: 4/30/16-9/30/21

Co-PIs: Aydogan Ozcan, Dino Di Carlo, Omai Garner

Funding: \$543,528

Award Number: 20160807

Project Title: PECASE: Tissue Integrating Injectable Microporous Scaffolds for Regenerative Healing, Sensing, and Drug Delivery

Source of Support: Office of Naval Research

Total Award Period Covered: 8/1/16-7/31/21

PI: Dino Di Carlo

Funding: \$1,000,000

Award Number: N00014-16-1-2997

Project Title: Secretion Encoding for Multiparameter Functional Immune Assays

Source of Support: NIH

Total Award Period Covered: 10/1/15-9/30/20

PI: Christopher Puleo, **Co-I:** Dino Di Carlo

Funding: \$614,400

Award Number: 1U24AI18667

COMPLETED GRANTS

Project Title: Particle-drops for democratization of digital assays

Source of Support: NIH

Total Award Period Covered: 9/16/17-8/31/19

PI: Dino Di Carlo,

Funding: \$338,087

Award Number: 1R21GM126414-01

Project Title: Force phenotyping of airway smooth muscle cells to develop novel asthma therapies

Source of Support: NIH

Total Award Period Covered: 4/1/17-1/31/19

PI: Dino Di Carlo, **Co-I:** Reynold Panettieri

Funding: \$209,125

Award Number: 1R21EB024081-01

Project Title: Smooth muscle cell-based assessment and therapy for myopathic forms of cipo

Source of Support: NIH

Total Award Period Covered: 6/1/17-5/31/19

PI: Martin Martin, **Co-I:** Dino Di Carlo

Funding: \$25,543

Award Number: 1R21DK111216-01A1

Project Title: EAGER: biomanufacturing: large scale isolation of T cells with high-performance phenotype
Source of Support: NSF **Award Number:** 1645406
Total Award Period Covered: 1/1/17-12/31/18
PI: Yvonne Chen, **Co-I:** Dino Di Carlo
Funding: \$110,000

Project Title: Project 1: Development of a microfluidic technology that focuses and orders single cells in a microchannel with high throughput
Source of Support: Japan Science and Technology Agency **Award Number:** 20152706
Total Award Period Covered: 4/1/15-4/31/19
PI: Dino Di Carlo
Funding: \$570,963.60

Project Title: Development and characterization of vortex instrument for trapping rare cells - amendment
Source of Support: Vortex Biosciences **Award Number:** 20161394
Total Award Period Covered: 3/28/16-1/31/18
PI: Dino Di Carlo
Funding: \$686,597

Project Title: A frequency-multiplexed flow cytometer for high throughput screening and drug discovery
Source of Support: NIH **Award Number:** R21EB019645
Total Award Period Covered: 8/1/15-12/31/17
PI: Dino Di Carlo
Funding: \$192,500

Project Title: EFRI-BioFlex: Cellphone-based Digital Immunoassay Platform for High-throughput Sensitive and Multiplexed Detection and Distributed Spatio-Temporal Analysis of Influenza
Source of Support: National Science Foundation **Award Number:** 1332275
Total Award Period Covered: 9/1/13-8/31/17
Co-PIs: Aydogan Ozcan, Dino Di Carlo
Funding: \$800,000

Project Title: Isolating Circulating Tumor Cells Using a Centrifuge on a Chip
Source of Support: NIH **Award Number:** R33CA177456
Total Award Period Covered: 8/16/13-7/31/16
PI: Dino Di Carlo
Funding: \$718,565

Project Title: Engineering injectable microporous hydrogels for brain repair
Source of Support: NIH **Award Number:** 1R01NS094599
Total Award Period Covered: 6/1/16-12/31/17
PI: Tatiana Segura, **Co-I:** Dino Di Carlo
Funding: \$79,076

Project Title: Collaborative Research: CDS&E: Sculpting fluid flow using a programmed sequence of micro-pillars
Source of Support: NSF **Award Number:** 1307550
Total Award Period Covered: 9/1/13-8/31/16
Co-PIs: Baskar Ganapathysubramanian (Iowa State), Dino Di Carlo, Jaroslaw S. Zola (Rutgers)
Funding: \$182,993

Project Title: Selective Cell Isolation in Microscale Vortices
Source of Support: Office of Naval Research, Young Investigator Award **Award Number:** N00014-12-1-0847
Total Award Period Covered: 8/1/12-7/31/16
PI: Dino Di Carlo
Funding: \$506,946

Project Title: High-throughput Single-cell Biophysics
Source of Support: National Science Foundation, CAREER Award **Award Number:** 1150588

Total Award Period Covered: 6/1/12-5/31/17

PI: Dino Di Carlo

Funding: \$448,329

Project Title: Deformability Cytometry – High-throughput Label-free Mechanical Analysis of Cellular Phenotype

Source of Support: Packard Fellowship, Packard Foundation

Award Number: 2011-37147

Total Award Period Covered: 9/1/11-8/31/16

PI: Dino Di Carlo

Funding: \$875,000

Project Title: Development and characterization of vortex instrument for trapping rare cells

Source of Support: Vortex Biosciences

Award Number: 20142277

Total Award Period Covered: 1/31/14-4/30/16

PI: Dino Di Carlo

Funding: \$710,931

Project/Proposal Title: Inertial Focusing for the Guava Flow Cytometry Architecture

Source of Support: Millipore Corporation

Total Award Amount: \$74,000

Total Award Period Covered: 9/1/11-8/31/12

PI: Dino Di Carlo

Project/Proposal Title: High-Throughput Mechanical Characterization of Cell State and Function

Source of Support: Defense Advanced Research Projects Agency (DARPA) Young Faculty Award

Total Award Amount: \$298,229

Total Award Period Covered: 8/1/11-7/31/13

PI: Dino Di Carlo

Project/Proposal Title: Electro-Adaptive Microfluidics (EAM) for Applications in Bio/medical, Sensing & Actuation

Source of Support: Defense Advanced Research Projects Agency (DARPA)

Total Award Amount: \$208,000

Total Award Period Covered: 9/23/10-9/22/11

PI: Dino Di Carlo, **Co-PI:** Qibing Pei

Project/Proposal Title: Engineering the intracellular micro- and nanoenvironment

Source of Support: NIH, Director's New Innovator Award

Total Award Amount: \$2,310,000 (1,500,000 direct cost)

Total Award Period Covered: 9/30/10-8/31/15

PI: Dino Di Carlo

Project/Proposal Title: Filterless inertial concentrator for rare cell enrichment from large volumes of blood

Source of Support: Wallace H. Coulter Foundation, Coulter Translational Research Award

Total Award Amount: \$180,000

Total Award Period Covered: 9/1/10-8/31/12

PI: Dino Di Carlo

Project/Proposal Title: Massively parallel rogue cell detection using serial time-encoded amplified microscopy of inertially ordered cells in high-throughput flow

Source of Support: Department of Defense, Breast Cancer Research Program Idea Award

Total Award Amount: \$790,402 (my share \$323,219)

Total Award Period Covered: 2/1/10-1/31/12

Co-PIs: Bahram Jalali, Dino Di Carlo

Project/Proposal Title: Ultra high-throughput holographic on-chip cytometry using inertial micro-fluidics

Source of Support: National Science Foundation, IDR-ECCS-EPDT

Total Award Amount: \$598,814 (my share \$298,450)

Total Award Period Covered: 9/1/09-8/31/12

Co-PIs: Aydogan Ozcan, Dino Di Carlo

Project/Proposal Title: Expansion of the Bioengineering Capstone Lab

Source of Support: Committee on Instructional Improvement - UCLA

Total Award Amount: \$9,283

Total Award Period Covered: 8/1/09-6/31/10

Co-PIs: Dino Di Carlo, Jacob Schmidt

Project/Proposal Title: Examining equilibrium focusing position dependence on particle deformability in an inertial flow

Source of Support: Council on Research Grant – UCLA Academic Senate

Total Award Amount: \$7,000

Total Award Period Covered: 7/1/09-6/31/10

PI: Dino Di Carlo

Project/Proposal Title: Point-of-care Microfluidic Cell Sorting System for Circulating Tumor Cells

Source of Support: American Cancer Society Postdoctoral Fellowship

Total Award Amount: \$94,000

Total Award Period Covered: 8/1/07-7/31/08

PI: Dino Di Carlo