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Biography

B.S. – 1978 (North Carolina State); M.S. – 1980 (Rensselaer Polytechnic); Ph.D. – 1983 (Cornell University)

In 1978, Shealy joined the technical staff of General Electric's Corporate Research & Development Center under an Edison Fellowship, where he developed GaAs epitaxial materials for high voltage electronics, and composite dielectrics for device fabrication by MOCVD. From this work, Shealy received two patents based on GaAs vertical field effect transistors. In 1980, Shealy transferred to General Electric's Advanced Electronics Laboratory where he developed the materials and a process for the fabrication of AlGaAs Light Emitting Diodes (LEDs). Shealy then developed an MOCVD reactor and process for the fabrication of AlGaAs quantum well laser diodes which resulted in the highest power, lowest threshold devices realized at that time. A novel and patented gas purification technique was developed and applied to the MOCVD process. Con-currently with the General Electric employment, Shealy worked at Cornell, and in 1984, Shealy's group at Cornell developed the first single quantum well red laser by MOCVD (emitting over 1 watt of power at 650 nm). In 1985, Shealy was designated a Principle Staff Scientist in General Electric in recognition of his research contributions.

After a decade with General Electric, Shealy joined the Cornell faculty in 1987. He continued the MOCVD related materials research which included the preparation of epitaxial structures for LEDs, laser diodes and high frequency transistors, all using GaAs or InP based materials. Also during this time, he developed a direct write process for laser stimulated epitaxial growth of quantum dots. In 1994, Shealy began research on GaN and related materials for both LEDs and high power transistors. This work resulted in a new nucleation technique for GaN materials on substrates including sapphire, SiC and Si. Shealy's group then produced the first operational GaN microwave transistor on a Si substrate. In 1997, Shealy became the Director of Cornell's Optoelectronics Technology Center, a joint research program with UCSB focusing on compound semiconductor optoelectronic devices. With a decade of funding (from the Office of Naval Research and DARPA), which includes a MURI program which Shealy was PI, several bench marks on GaN transistor performance were achieved, and several patents were issued on key aspects of the technology. In 1999, Shealy's group at Cornell realized the first operational GaN microwave transistors on Silicon substrates, a technology that is currently entering production in dozens of companies worldwide. In parallel, work progressed on realizing defect free GaN materials on micro-machined Si (also patented) which led to the development of operational pyramidal pn junction diodes in GaN. These structures are under investigation for realizing high efficiency surface emitting UV LEDs.

In 1998, Shealy was promoted to Full Professor at Cornell and he is a member of the graduate faculty of Electrical and Computer Engineering and Materials Science. He has received multiple awards for excellence in under-graduate teaching and has developed new courses in semiconductor materials and nanofabrication. While at Cornell, he has also consulted for dozens of US companies (including GE, GM, Motorola, Raytheon, NGC, Cree, RFMD, Honeywell, Welch Allyn) on the subject of compound semiconductor materials and devices. Shealy has published in excess of 250 Journal articles and is the inventor of over 15 patents, roughly half of which, involve GaN-based materials and devices. Shealy's work also includes the development of new dielectric passivation materials for GaN transistors which has resulted in unprecedented power performance for submicron-gated GaN transistors. This level of performance still represents the state-of-the-art in the present day. Shealy's publications have received over 10,000 citations by colleagues around the world working in semiconductor electronics.

In 2002, Shealy was co-founder and technical advisor to RF Nitro Communications which developed high performance GaN-based electronics. RF Nitro became the Charlotte division of RF Micro-Devices, a US company which merged into Qorvo in 2015. In 2009, Shealy co-founded two other companies, one involved in the manufacture of GaAs-based MMICs and the other taking advantage of new intellectual property in pursuit of high power GaN electronics. In 2015, Shealy co-founded Akoustis Technologies (publicly traded on the NASDAQ) which has developed next generation Bulk Acoustic Wave (BAW) filters using AlN single crystal materials for use in the 5G mobile communications cellular market. Akoustis is currently manufacturing these devices in their MEMs fabrication facility in upstate New York.

EXPERT WITNESS EXPERIENCE:

Since 2007, Shealy has engaged in expert witness related consulting in technical field of Gallium Nitride electronics and optoelectronics. A list of engagements follow.

- ITC in 2007-2009, Investigation No. 337-TA-640,"Certain LEDs, Laser Diodes and Products Containing Same," Rothschild vs. Sony, Toshiba, Sharp, etc. Albert Jacobs LLP.,US Patent 5,252,499.
- US District Court, Southern District of New York in 2008-2009, 05_CIV-5939 (WGY), "Rothschild vs. Cree, Inc.," Albert Jacobs LLP., US Patent 5,252,499.
- US District Court, Southern District of New York in 2010, 05_CIV-5939 (WGY), "Rothschild vs. Cree, Inc.," Troutman Sanders LLP., US Patent 5,252,499.
- US District Court, District of Massachusetts in 2010-2011, Civil Action No. 11-10133-WGY, "Rothschild vs. Cree, Inc.," Troutman Sanders LLP., US Patents 4,904,618 and 5,252,499.

- District Court Dusseldorf in 2011-2012, Civil Action No. 11-10133-WGY, "Rothschild vs. OSRAM," Lang & Rahman Rechtsanwälte, US Patent 5,252,499.
- ITC in 2012, Investigation No. 337-TA-802, "Certain LEDs, Laser Diodes and Products Containing Same," LG vs. OSRAM, Finnegan, Henderson, Farabow, Garrett & Dunner LLP., US Patent 7,928,465.
- US PTO in 2014-2015, Inter Partes Review of U.S. Patent 6,692,251, Ultradent vs. Kerr Corporation, Stoel Rivers LLP.
- US District Court, District of Delaware in 2013-2014, Civil No. 1:12-cv-923-GMS, "Schubert vs. OSRAM," Troutman Sanders LLP., US Patent 6,294,475.
- US PTO in 2013-2014, Inter Partes Review of U.S. Patent 6,294,475, "Schubert vs. OSRAM", Troutman Sanders LLP.
- ITC in 2015, Investigation No. 337-TA-947, "Certain Light Emitting Diode Products and Components Thereof," CREE vs. Feit Electric Co. & Unity Opto Technology, Quinn Emanuel Urquhart & Sullivan, LLP., US Patent 8,766,298 B2.

SELECTED RESEARCH PUBLICATIONS:

"Hydrodynamic simulation of surface traps in the AlGa_N/Ga_N HEMT", Brannick, A; Zakhleniuk, NA; Ridley, BK; Eastman, LF; **Shealy, JR**; Schaff, WJ. *Workshop on Recent Advances on Low Dimensional Structures and Devices*, 07-09, April, 2008.

"Influence of Field Plate on the Transient Operation of the AlGa_N/Ga_N HEMT", Brannick, A; Zakhleniuk, NA; Ridley, BK; **Shealy, JR**; Schaff, WJ; Eastman, LF. *IEEE Electron Device Letters*, **30** (5):436-438 2009

"Frequency dispersion in capacitance-voltage characteristics of AlGa_N/Ga_N heterostructures", **Shealy, JR**; Brown, RJ, *Applied Physics Letters*, **92** (3): Art No. 032101 2008

"Methodology for small-signal model extraction of AlGa_NHEMT's", **Shealy, JR**; Wang, JL; Brown, R. *IEEE Transactions on Electron Devices* **55** (7):1603-1613- 2008

"Comparative analysis of hot-electron transport in AlGa_N/Ga_N and AlGa_N/Al_N/Ga_N 2DEG channels", Ardaravicius, L; Ramonas, M; Kiprijanovic, O; Liberis, J; Matulionis, A; Eastman, LF; **Shealy, JR**; Chen, X; Sun, YJ. *Physica Status Solidi A-Applications and Materials Science* **202** (5):808-811 2005

"Signal generation, control, and frequency conversion AlGa_N/Ga_N HEMT MMIC's", Kaper, VS; Thompson, RM; Prunty, TR; **Shealy, JR**. *IEEE Transactions on Microwave Theory and Techniques* **53** (1):55-65 2005

“Electron transport and microwave noise in MBE- and MOCVD-grown AlGa_N/AlN/GaN”, Matulionis, A; Liberis, J; Eastman, LF; Schaff, WJ; **Shealy, JR**; Chen, X; Sun, YJ. *Acta Physica Polonica A* **107** (2):361-364 2005

“Influence of Si₃N₄ passivation on surface trapping in SiC metal-semiconductor field-effect transistors”, Cha, HY; Choi, YC; Thompson, RM; Kaper, V; **Shealy, JR**; Eastman, LF; Spencer, MG. *Journal of Electronic Materials* **33** (8):908-911 2004

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R. Thompson, T. Prunty, V. Kaper, and **J.R. Shealy**, “Performance of the AlGa_N HEMT Structure With a Gate Extension”, IEEE Transactions of Electron Devices, Vol 51, No 2, February 2004.

L. Ardaravicius, A. Matulionis, J. Liberis, O Kiprijanovic, M. Ramonas, L.F. Eastman, **J.R. Shealy** and A. Vertiatchikh, “Electron Drift Velocity in AlGa_N/Ga_N channel at high electric fields”, Appl. Phys. J., Vol 83, No. 19, pp. 4038-4040, Nov 2003

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R. Thompson, V. Kaper, T. Prunty, **J.R. Shealy**, “Improved Fabrication Process for Obtaining High Power Density AlGa_N/Ga_N HEMT’s”, Gallium Arsenide Integrated

Circuit (GaAs IC) Symposium, 2003. 25th Annual Technical Digest 2003, IEEE, 2003 pp.298-300.

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