

Dr. Douglas B. Shire, Ph.D.

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Cornell University
Department of Electrical Engineering
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Education:

- Cornell University Postdoc. 1994 - 1997 Electrical Engineering
Developed, fabricated, and tested coupled in-plane and vertical-cavity surface emitting laser 1xN optoelectronic routing switches with bistable operation for all-optical logic. *Adviser: C.L. Tang*
- Cornell University Ph.D. 1984 - 1989 Electrical Engineering
Thesis topic: Development and Characterization of Traveling-Wave MODFETs. Adviser: L.F. Eastman
A new type of traveling wave transistor was designed, microfabricated, and characterized using a femtosecond laser and a non-invasive finger-type voltage probe at the University of Michigan.
- Rensselaer Polytechnic Institute B.S. 1980 - 1984 Electrical Engineering

Work Experience:

- 2002-present Research Scientist, Boston VA Healthcare System
- 2006-2012 Engineering Manager, Ctr. for Innovative Visual Rehabilitation, Boston VA Healthcare System
- Led a team of 5 engineers and 1 technician to develop a record high-density retinal prosthesis to restore useful vision to blind patients. Provided program management across disciplines and multiple work sites, performed and supervised microfabrication, coordinated vendors, established and maintained quality management systems to ISO standards. Co-wrote grant proposals raising over \$30M in Government financing. Worked to establish start-up company, Bionic Eye Technologies, Inc., to commercialize this technology.
- 1997-present Visiting Scientist, Nanofabrication Facility, Cornell University, Ithaca, NY
- Over 25 years of experience in all aspects of front- and back-end microfabrication technology: optical and e-beam lithography, wet and dry etching, physical and chemical vapor deposition, sputtering, lapping, dicing, CAD, optical and electronic characterization, and more. Significant experience in new process development, hands-on problem solving and tool specification, management, and maintenance. Trained in design of experiments and dry etching technology.
- 1989-1994 Research Engineer, Hewlett-Packard Co., Optoelectronics Division, San Jose, CA
- Developed and characterized microfabrication processes for optoelectronic devices, including early blue LEDs and print-heads for LED-based copiers and printers. Transferred production to volume manufacturing fabs in Silicon Valley and in Malaysia. Instituted award-winning hazardous waste reduction program.
- 1994-1997 Adjunct Associate Professor of Electrical Engineering, Syracuse University, NY
- Taught courses in microfabrication technology (with lab) and semiconductor electronics.

Awards:

1984	Eta Kappa Nu, Tau Beta Pi (Engineering Honorary Societies)
1984	IEEE Student Paper Prize – 1 st Place
1984	Henry Nolte Prize for Outstanding Undergraduate Research
1989	HAZMACON Award for Best Hazardous Waste Reduction Program
2009	Principal Investigator, VA Merit Review Research Grant
2011	Marquis Who's Who In America
2012	BEACON Medical Technology Award
2013	Principal Investigator, VA SPiRE Award

Patents, Invited Papers, and Journal Articles:

S. Kelly, D. B. Shire, J. Chen, P. Doyle, M. Gingerich, S. Cogan, W. Drohan, S. Behan, L. Theogarajan, J. L. Wyatt, and J.F. Rizzo 3rd, "A Hermetic Wireless Subretinal Neurostimulator for Vision Prostheses," IEEE Trans. Biomed. Eng. 2011, vol. 58, no. 11, pp. 3197-3205 (featured cover article).

S.K. Kelly, D.B. Shire, J. Chen, P. Doyle, M.D. Gingerich, S.F. Cogan, W. Drohan, L. Theogarajan, J.L. Wyatt, and J.F. Rizzo. "Communication and Control System for a 15-Channel Hermetic Retinal Prosthesis." Biomed. Sig. Proc. and Control, 2011, vol. 6, No. 4, pp. 356-363.

D. B. Shire, S. Kelly, J. Chen, P. Doyle, M. Gingerich, S. Cogan, W. Drohan, O. Mendoza, L. Theogarajan, J. Wyatt, and J.F. Rizzo 3rd, "Development and implantation of a minimally-invasive wirelessly-driven sub-retinal neurostimulator," IEEE Trans. Biomed. Eng. 2009 vol. 56, no. 10, pp. 2502-2511 (featured cover article).

S. F. Cogan, J. Ehrlich, T.D. Plante, A. Smirnov, D. B. Shire, M. Gingerich, and J. F. Rizzo 3rd, "Sputtered iridium oxide films (SIROFs) for neural stimulation electrodes," J. Biomed. Mater. Res. B: Appl. Biomater. 2009 vol. 89B, no. 2, pp. 353-361.

C. Scholz, W. Vayaboury, R. Sweitzer, D. B. Shire, and J. F. Rizzo, "Surface modification of retinal implants," Polymer Preprints, 2006 vol. 47, no. 2, pp. 159-160.

J. F. Rizzo, J. Wyatt, J. Loewenstein, S. Kelly, and D. Shire, "Methods and Perceptual Thresholds for Short-Term Electrical Stimulation of Human Retina with Microelectrode Arrays," Invest. Ophthalmol. Vis. Sci. 2003 vol. 44, no. 12, pp. 5355-5361.

J. F. Rizzo, J. Wyatt, J. Loewenstein, S. Kelly, and D. Shire, "Perceptual Efficacy of Electrical Stimulation of Human Retina with a Microelectrode Array During Short-Term Surgical Trials," Invest. Ophthalmol. Vis. Sci. 2003 vol. 44, no. 12, pp. 5362-5369.

D. Shire, J. L. Wyatt, and J. F. Rizzo, "Inflatable Retinal Prosthesis," US Patent No. 6,368,349, dated April 9, 2002

J. Wyatt, D. Shire, and J. F. Rizzo, "Chronically Implantable Retinal Prosthesis," US Patent No. 6,324,429, dated November 27, 2001.

D. B. Shire, C. L. Tang, M. A. Parker, C. Lei, and L. Hodge, "Bistable Operation of Coupled In-Plane and Oxide-Confined Vertical-Cavity Laser 1xN Routing Switches," Applied Physics Letters, 1997, vol. 71, no. 21, pp. 3039-3041.

M. A. Parker, R. J. Michalak, J. S. Kimmet, A. R. Pirich, and D. B. Shire, "Etched-surface Roughness Measurements from an In-Situ Laser Reflectometer," Applied Physics Letters, 1996, vol. 69, no. 10, pp. 1459-1461.

D. B. Shire, C. L. Tang, and M. Hong, "Coupled In-Plane and Vertical-Cavity Laser 1xN Routing Switches," IEEE Photonics Technology Letters, 1996, vol. 8, no. 11, pp. 3039-3041.

M.A. Parker, J. S. Kimmet, R. J. Michalak, H. S. Wang, D. B. Shire, C. L. Tang, and J. P. Drumheller, "Accurate Electron-Cyclotron-Resonance Etching of Semiconductor Laser Heterostructures Using a Simple Laser Reflectometer," IEEE Photonics Technology Letters, 1996, vol. 8, no. 6, pp. 818-820.

D. B. Shire, M. A. Parker, and C. L. Tang, "Multiple-Input Optical Control of Vertical Cavity Surface Emitting Lasers Using Intracavity-Coupled In-Plane Lasers," IEEE Photonics Technology Letters, 1996, vol. 8, no. 2, pp. 188-190.

P. D. Swanson, D. B. Shire, C. L. Tang, M. A. Parker, J. S. Kimmet, and R. J. Michalak, "Electron-Cyclotron Resonance Etching of Mirrors for Ridge-Guided Lasers," IEEE Photonics Technology Letters, 1995, vol. 7, no. 6, pp. 605-607.

D. Shire, "Hazardous Waste Minimization in III-V Wafer Fabrication Processes," IEEE Trans. Components, Packaging, and Manufacturing Technology, 1994, vol. 17, no. 4, pp. 521-527.

Selected Conference Presentations:

D.B. Shire, W.F. Ellersick, S.K. Kelly, P. Doyle, A. Priplata, W. Drohan, O. Mendoza, M.D. Gingerich, B. McKee, J.L. Wyatt, and J.F. Rizzo, "ASIC Design and Data Communications for the Boston Retinal Prosthesis," in Proc. 35th IEEE Engineering in Medicine and Biology Conf., 2012, pp. 292-295.

D.B. Shire, T. Salzer, W.K. Jones, B. McKee, M.D. Gingerich, J.L. Wyatt, and J.F. Rizzo, "Bonding and Packaging Advancements to the Boston Retinal Prosthesis," Invest. Ophthalmol. Vis. Sci., 2011 52:4 4966 (in Proc. ARVO).

J.F. Rizzo, D.B. Shire, S. Kelly, P. Troyk, M. Gingerich, B. McKee, A. Priplata, J. Chen, W. Drohan, P. Doyle, O. Mendoza, L. Theogarajan, S. Cogan, J. Wyatt. "Development of the Boston Retinal Prosthesis." in Proc. IEEE Engineering in Medicine and Biology Conf., 2011, pp. 3135-3138.

D. B. Shire, T. Salzer, W. K. Jones, R. Akhmechet, M. D. Gingerich, J. L. Wyatt, and J. F. Rizzo, "High Density Bonding to Next Generation Hermetic Packaging for the Boston Retinal Prosthesis." Invest. Ophthalmol. Vis. Sci., 2010 51:4 3037 (in Proc. ARVO).

D.B. Shire, P. Doyle, S.K. Kelly, M.D. Gingerich, J. Chen, S.F. Cogan, W.A. Drohan, O. Mendoza, L. Theogarajan, J.L. Wyatt, and J.F. Rizzo, "In Vivo Operation of the Boston 15-Channel Wireless Subretinal Visual Prosthesis," in Proc. SPIE IS&T Electronic Imaging Conf., 2010, vol. 7527, paper 752705.

M. D. Gingerich, D. B. Shire, S. F. Cogan, T. Plante, J. L. Wyatt, and J. F. Rizzo, "A Microfabricated Subretinal Electrode Array With an Integrated a-SiC Barrier." Invest. Ophthalmol. Vis. Sci., 2010 51:4 3040 (in Proc. ARVO).

D.B. Shire, S.K. Kelly, M.D. Gingerich, O. Mendoza, W. Drohan, J.H. Chen, J.F. Rizzo III and J.L. Wyatt, "Long-Term in-vivo Operation of the Wireless Boston Retinal Neuroprosthesis," Invest. Ophthalmol. Vis. Sci. 2009 50:4 4596 (in Proc. ARVO).

S.K. Kelly, D.B. Shire, J. Chen, P. Doyle, M.D. Gingerich, W.A. Drohan, L.S. Theogarajan, S.F. Cogan, J.L. Wyatt, J.F. Rizzo III. "The Boston Retinal Prosthesis: A 15-Channel Hermetic Wireless Neural Stimulator." In Proc. IEEE ISABEL International Symposium on Applied Sciences in Biomedical and Communication Technologies. Invited paper, 2009 - Received Best Paper Award.

S.K. Kelly, D.B. Shire, J. Chen, P. Doyle, M.D. Gingerich, W.A. Drohan, L.S. Theogarajan, S.F. Cogan, J.L. Wyatt, J.F. Rizzo III. "Realization of a 15-Channel, Hermetically-Encased Wireless Subretinal Prosthesis for the Blind." In Proc. IEEE Engineering in Medicine and Biology Conference, 2009, pp. 200-203.

L.S. Theogarajan, D.B. Shire, S.K. Kelly, J.L. Wyatt, J.F. Rizzo. "Visual Prostheses: Current Progress and Challenges." VLSI - Design and Test Conference, Taiwan, 2009.

J.F. Rizzo III, J. Chen, D. Shire, M. Gingerich, J. Sandell, and S. Cogan, "Collective Summary of *in vivo* Experiments of Sub-Retinal Implantation of Microfabricated Electrode Arrays in Pigs," Invest. Ophthalmol. Vis. Sci. 2009 50:4 4746 (in Proc. ARVO).

M.D. Gingerich, R. Akhmechet, O.R. Ziv, D.B. Shire, J.L. Wyatt, and J.F. Rizzo III, "Microfabricated Multi-Electrode Arrays for *in vitro* Study of Neural Coding in the Retina," Invest. Ophthalmol. Vis. Sci. 2009 50:4 4587.

S.K. Kelly, P. Doyle, O. Mendoza, W.A. Drohan, G.W. Swider, D.B. Shire, J.L. Wyatt, and J.F. Rizzo III, "Improved Class A Based Transmitter System for Wireless Retinal Implant Data Telemetry," Invest. Ophthalmol. Vis. Sci. 2009 50:4 4578.

D.B. Shire and S.K. Kelly, "Chronic Implantation of a Wireless Subretinal Neurostimulator in Yucatan Minipigs," in Proc. Eye and the Chip World Congress on Artificial Vision, 2008, Detroit, MI, June 12-14.

D.B. Shire, S.K. Kelly, M.D. Gingerich, O. Mendoza, G. Swider, W. Drohan, J. Chen, J.F. Rizzo, and J.L. Wyatt, "Operation of a Wirelessly Powered Subretinal Neurostimulator," Invest. Ophthalmol. Vis. Sci. 2008 49:4 3031 (in Proc. ARVO).

J.F. Rizzo, J. Chen, D.B. Shire, S. Kelly, M. Gingerich, G. Swider, W. Drohan, and J.L. Wyatt, "Implantation of a Wirelessly Powered Retinal Prosthesis Using an *ab externo* Surgical Technique," Invest. Ophthalmol. Vis. Sci. 2008 49:4 3027 (in Proc. ARVO).

M.D. Gingerich, R. Akhmechet, D.B. Shire, J.L. Wyatt, and J.F. Rizzo, "Development of a Flexible High-Density Multi-Layered Metallization Interconnect Technology for a Subretinal Prosthesis," Invest. Ophthalmol. Vis. Sci. 2008 49:4 3035 (in Proc. ARVO).

D. B. Shire, O. R. Ziv, M. D. Gingerich, R. Jensen, J. F. Rizzo, S. F. Cogan, and J. L. Wyatt, "Progress Toward a Platform for Studying Neural Coding of Vision: Recordings From a Flexible, Transparent Multielectrode Array," Invest. Ophthalmol. Vis. Sci. 2007 48:4 658 (in Proc. ARVO).

S. F. Cogan, J. Ehrlich, T. D. Plante, D. B. Shire, M. Gingerich, and J. F. Rizzo, "Sputtered Iridium Oxide Films (SIROFS) for Retinal Stimulation Electrodes," Invest. Ophthalmol. Vis. Sci. 2007 48:4 660 (in Proc. ARVO).

D.B. Shire, S. F. Cogan, M. D. Gingerich, J. L. Wyatt, and J.F. Rizzo, "Transparent Epiretinal Electrode Array for Chronic Recording to Study Neural Coding for Vision," Invest. Ophthalmol. Vis. Sci. 2006 47:4 3162 (in Proc. ARVO).

L. Theogarajan, J. Wyatt, J. Rizzo, B. Drohan, M. Markova, S. Kelly, G. Swider, M. Raj, D. Shire, M. Gingerich, J. Loewenstein, B. Yomtov, "Minimally Invasive Retinal Prosthesis," in Proc. IEEE International Solid-State Circuits Conference (ISSCC), 2006, paper 2.5, pp. 99-108.

D.B. Shire, M. Gingerich, J.F. Rizzo, and J.L. Wyatt, "Recent Developments in Inflatable Prostheses for Epiretinal Stimulation and/or Recording," Invest. Ophthalmol. Vis. Sci. 2005 46:4 1534 (in Proc. ARVO).

D.B. Shire, M. Gingerich, S. Retterer, L. Theogarajan, S. Kelly, M. Markova, M. Raj, S. Cogan, J. Wyatt, and J.F. Rizzo, "Design and Fabrication of an *Ab-Externo* Retinal Prosthesis," Invest. Ophthalmol. Vis. Sci. 2004 45:4 4177 (in Proc. ARVO).

D.B. Shire, M. Gingerich, L. Theogarajan, J. Wyatt, J. Loewenstein, S. Montezuma, and J. Rizzo, "Packaging Development for Retinal Prostheses," Invest. Ophthalmol. Vis. Sci. 2003 44:4 5084 (in Proc. ARVO).

D. Shire and J. F. Rizzo, "Microfabrication Initiatives at the VA Center for Innovative Visual Rehabilitation (CIVR)," Invited Paper, in Proc. 2nd Joint IEEE EMBS-BMES Conference, 2002, vol. 3, p. 2399.

Past Funded Research Support:

VA/C6837R “High Density Hermetic Packaging for Next-Generation Neural Prostheses” This VA Merit Review grant focused on the development of an ultra-high density hermetic package for the CIVR retinal prosthesis having 200+ inputs or outputs (I/O). Dr. Shire’s role as PI was to oversee the research, lead the micro-fabrication effort to create co-fired ceramic/titanium micro-packages in collaboration with a suite of vendors, and coordinate *in vitro* and *in vivo* testing of the devices in mini-pig animal models.
10/1/2010 – 9/30/2013

VA/C4266C “Center for Innovative Visual Rehabilitation (CIVR)” The overall aim of the VA CIVR was to develop a wirelessly powered neural prosthesis to restore useful vision to patients who are blind with degenerative retinal disease. Dr. Shire’s role in this program was to manage the entire engineering effort across multiple research and vendor sites, and to coordinate pre-clinical animal studies with the surgical team.
4/1/2006 – 3/31/2011

NSF/IIS-0515134 “Development of a Technological Platform to Study the Neural Code for Vision” The goals of this grant were to perform “learning” experiments to develop communication strategies with the brain. Dr. Shire’s role in this program was Principal Investigator on a sub-contract to supervise the engineering effort across multiple research sites and to fabricate flexible electrode arrays for *in vitro* and *in vivo* studies.
8/1/2009 - 7/31/2012

NIH/EY016674-01 “Engineering Development of a Chronic Retinal Implant” This effort aimed to solve key technical issues common to all neural prostheses in low-power circuit design, hermetic packaging, and biocompatible surface coatings. Dr. Shire managed the engineering and microfabrication efforts.
10/1/2008 – 9/31/2011

Current/Pending Funded Research Support:

VA SPiRE Award “In-Line 32-Channel Connector for High-Density Implantable Medical Device” This award focuses on the development of a high-density in-line connector for next-generation neurostimulators and related implantable devices. Dr. Shire’s role is PI, with APT Center co-investigators Drs. Tyler and Triolo.
10/1/2013 - 1/1/2015

VA Merit Review Award “Next-Generation High-Density Wireless Peripheral Nerve Stimulator” This award will focus on the adaptation of the high-density neurostimulator developed by PI Shire and his VA colleagues at the Center for Innovative Visual Rehabilitation, to peripheral nerve applications. APT Center co-investigators Drs. Tyler and Triolo will also contribute to this effort.
4/1/2014 – 3/31/2017

Professional Activities and Service

Memberships: IEEE, ARVO (2004 – Present)

Peer Reviewer: IOP, IEEE Biomedical Engineering Journals (2006 – Present)

VA: Career Development Award panel member