Stephen Ducharme
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Areas of Interest

Nanostructured and 2D Organic Materials: Focusing on properties and functions of functional organic materials at the nanoscale, expecially as dimensionality and nanoscale structuring and hierarchical integration afford new or improved functionalities.

Functional Organic Materials: Focusing on the fundamental study of physical propertiesrelated to ferroelectricity, piezoelectricity, pyroelectricity, nonlinear optical response, photovoltaic response, and dielectric response of organic materials and how these properties can be tailored and enhanced through novel materials synthesis and processing.

Fundamentals of Ferroelectricity: Focusing on the origins and nature of ferroelectricity and other long-range dielectric and electromechanical interactions in polymeric and molecular organic materials.

Professional Preparation

University of Lowell, Massachusetts	Physics	B.S.	1981
University of Southern California	Physics	M.A.	1982
University of Southern California	Physics	Ph.D.	1986
University of Utah	Physics	Post-doc	1986-88

Appointments

2001 – present Professor: Department of Physics and Astronomy, University of Nebraska-Lincoln (UNL)
2001 – 2013 Vice Chair: Department of Physics and Astronomy, UNL
1996 – 2001 Associate Professor: Department of Physics and Astronomy, UNL
1991 – 1996 Assistant Professor: Department of Physics and Astronomy, UNL
1988 – 1990 Visiting Scientist: IBM Almaden Research Center, San Jose, California

Synergistic Activities

UNL Speakers Bureau (2009 to present)**:** Community Outreach and Education. I am one of approximately 30 faculty who represent the University by giving lectures and demonstrations to community organizations, school, and public events.
http://speakersbureau.unl.edu/speakers

Plenary Speaker: *Workshop on Electrically Active Materials for Medical Devices*, 8-10 June 2015, Limerick, Ireland. This workshop brought together academic and industry researchers with expertise in electroactive materials suitable for use in medical devices and technology. My role was to review work on nanoscale properties of organic and biocompatible ferroelectric polymers.

Co-Chair & Co-Editor (1995-1999, 5 Vol.): *SPIE Symposium on Organic Photorefractive Materials and Xerographic Photoreceptors*, with P. M. Borsenberger (1995, J. M. Stasiak (1996-98), D. H. Dunlap and R. A. Norwood (1999). SPIE Proccedings Vol, 2526, 2850, 2144, 2471, 3799. This was an annual meeting bringing together a diverse interdisciplinary group of academic and industry researchers to focus on fundamental science.

Chair (2011 to 2012, 2016 to present)**:** Education and Outreach Committee of the Nebraska Center for Materials and Nanoscience. The Committee oversees the extensive outreach and

education activities of the NCMN, including the following: NanoDays event at a local mall, which engages hundreds of curious visitors of all ages; over a dozen workshops and camp activities for K-12 students and K-12 teachers; public lectures; science slams; a travelling nanoscience museum exhibit; an annual competition and travelling exhibit of nanoart by scientists; and tours of research facilities. http://ncmn.unl.edu/outreach-education

Curriculum Development: *Physics of Lasers and Modern Optics*, a hands-on laboratory course for STEM majors emphasizing principles and techniques of optical and laser technology used in scientific research and technology. The course is taught annually by faculty in the Department of Physics and Astronomy and has served over 120 STEM students since its inception. Course development was supported by the NSF Instrumentation for Laboratory Improvement program (ILI-9451719).

Thesis Supervisor for physics graduates – 10 Ph.D., 5. M.S., 2 B.S.

Other Publications: Five patents, one book, six edited books, two book chapters. 34 invited and plenary talks, 40 guest lectures, 63 education and outreach presentations

Selected Publications (from over 200, Publons Profile A-1909-2009)

Nanostructured and 2D Organic Materials

Ferroelectricity at the Nanoscale, Vladimir Fridkin and S. Ducharme (Springer, Berlin, 2014), 132 pages. ISBN 978-3-642-41007-9 http://link.springer.com/book/10.1007%2F978-3-642-41007-9

"Diisopropylammonium Bromide Based Two-Dimensional Ferroelectric Monolayer Molecular Crystal with Large In-Plane Spontaneous Polarization," Ma, Liang; Jia, Yinglu; Ducharme, Steve; Wang, Jinlan; Zeng, Xiao Cheng, *Journal of the American Chemical Society* **141** (4), 1452-1456 (2019). http://dx.doi.org/10.1021/jacs.8b12102

"Ferroelectric polymer nanopillar arrays on flexible substrates by reverse nanoimprint lithography," Jingfeng Song, Haidong Lu, Shumin Li, Li Tan, Shireen Adenwalla, Alexei Gruverman, Stephen Ducharme, *Journal of Materials Chemistry C* **4** (25), 5914-5921 (2016). http://dx.doi.org/10.1039/C6TC01848C

"Hydrogel microphones for stealthy underwater listening," Yang Gao, Jingfeng Song, Shumin Li, Christian Elowsky, You Zhou, Stephen Ducharme, Yongmei Chen, Qin Zhou, Li Tan, *Nature Communications* **7**, 12316 (10) (2016). http://dx.doi.org/10.1038/ncomms12316

"Fabrication of Ferroelectric polymer nanostructures on flexible substrates by soft-mold reverse nanoimprint lithography," Jingfeng Song, Haidong Lu, Shumin Li, Li Tan, Alexei Gruverman, Stephen Ducharme, *Nanotechnology* **27**, 015302(9) (2016). http://dx.doi.org/10.1088/0957-4484/27/1/015302

"Ferroelectric-domain-patterning-controlled Schottky junction state in monolayer MoS_2," Zhiyong Xiao, Jingfeng Song, David K. Ferry, Stephen Ducharme, Xia Hong, *Physical Review Letters* **123**, 236801 (7) (2017). http://dx.doi.org/10.1103/PhysRevLett.118.236801

"2D Cocrystallization from H-bonded Organic Ferroelectrics," Donna A. Kunkel, James Hooper, Benjamin Bradley, Lisa Schlueter, Tom Rasmussen, Paulo Costa, Sumit Beniwal, Stephen Ducharme, Eva Zurek, Axel Enders, *Journal of Physical Chemistry Letters* **7**, 435-440 (2016). http://dx.doi.org/10.1021/acs.jpclett.5b02472

"Lateral-Structure Single-Crystal Hybrid Perovskite Solar Cells Via Piezoelectric Poling," by Q. Dong, J. Song, Y. Fang, Y. Shao, S. Ducharme and J. Huang, *Advanced Materials* **28**(14), 2816-2821 (2016). http://dx.doi.org/10.1002/adma.201505244

"Efficiency enhancement in organic solar cells with ferroelectric polymers," Yongbo Yuan, Timothy J. Reece, Pankaj Sharma, Shashi Poddar, Stephen Ducharme, Alexei

Gruverman, Yang Yang, Jinsong Huang, *Nature Materials* **11** (3), 296-302 (2011). http://dx.doi.org/10.1038/nmat2951.

"Two-Dimensional Ferroelectric Films," A. Bune, V. M. Fridkin, S. Ducharme, L. M. Blinov, S. P. Palto, A. Sorokin, S. G. Yudin, A. Zlatkin, *Nature* 391, 874-877 (1998). http://dx.doi.org/10.1038/36069.

"An Inside-Out Approach to Storing Electro-Static Energy," S. Ducharme, *ACS Nano* **3** (9), 2447–50 (2009). Invited Perspective article. http://dx.doi.org/10.1021/nn901078s

"Start the Presses," S. Ducharme and A. Gruverman, *Nature Materials* **8**, 9-10 (2009). Invited "News and Views" article. http://dx.doi.org/10.1038/nmat2348

Functional Organic Materials

"Large electrostrictive response in lead halide perovskites," B. Chen, T. Li, Q. Dong, E. Mosconi, J. Song, Z. Chen, Y. Deng, Y. Liu, S. Ducharme, A. Gruverman, F. De Angeles and J. Huang, *Nature Materials* **17**, 1020-2026 (2018). http://dx.doi.org/10.1038/s41563-018-0170-x "Charge collection kinetics on ferroelectric polymer surface using charge gradient microscopy," Yoon-Young Choi, Sheng Tong, Stephen Ducharme, Andreas Roelofs Seungbum Hong, *Scientific Reports* **6**, 25087 (8) (2016). http://dx.doi.org/10.1038/srep25087

"Statics and Dynamics of Ferroelectric Domains in Diisopropylammonium Bromide," Haidong Lu, Tao Li, Shashi Poddar, Om Goit, Alexey Lipatov, Alex Sinitskii, Stephen Ducharme, Alexei Gruverman, *Advanced Materials* **27**(47), 7832-7838 (2015). http://dx.doi.org/10.1002/adma.201504019

"Enhancement of local piezoresponse in polymer ferroelectrics via nanoscale control of microstructure," Yoon-Young Choi, Pankaj Sharma, Charudatta Phatak, David J. Gosztola, Yunya Liu, Joonseok Lee, Jiangyu Li, Alexei Gruverman, Stephen Ducharme, Seungbum Hong, *ACS Nano* **9** (2), 1809-1819 (2015). http://dx.doi.org/10.1021/nn5067232

"Understanding the effect of ferroelectric polarization on power conversion efficiency of organic photovoltaic devices," Y. B. Yuan, P. Sharma, Z. G. Xiao, S. Poddar, A. Gruverman, S. Ducharme, J. S. Huang, *Energy & Environmental Science* **5**, 8558-63 (2012). http://dx.doi.org/10.1039/C2ee22098a.

"Ferroelectric Polymer Langmuir-Blodgett Films for Nonvolatile Memory Applications," S. Ducharme, T. J. Reece, C. M. Othon, R. K. Rannow, *IEEE Transactions on Device and Material Reliability* **5**, 720-735 (2005). http://dx.doi.org/10.1109/TDMR.2005.860818.

"High Performance Photorefractive Polymers," M. Liphardt, A. Goonesekera, B. E. Jones, S. Ducharme, J. M. Takacs, L. Zhang, *Science* **263**, 367-369 (1994). http://dx.doi.org/10.1126/science.263.5145.367.

"Observation of the Photorefractive Effect in a Polymer," S. Ducharme, R. W. Twieg, J. C. Scott, W. E. Moerner, Physics Review Letters ***66****, 1846-1849 (1991). http://dx.doi.org/10.1103/PhysRevLett.66.1846.*

Fundamentals of Ferroelectricity

"Materials Genome Approach to Organic Ferroelectrics and Piezoelectrics," T. D. Usher, K. R. Cousins, D. C. Smith, R. Zhang, E. D. Zurek, S. Ducharme, S. J. Callori, D. P. Miller, and P. S. Costa, *International Journal of Nanotechnology* **15** (8/9/10), 784-791 (2018). http://dx.doi.org/10.1504/IJNT.2018.098449

"Finite-size scaling of flexoelectricity in Langmuir-Blodgett polymer thin films," Shashi Poddar, Keith Foreman, Shireen Adenwalla, Stephen Ducharme, *Applied Physics Letters* **108**, 012908 (5) (2016). http://dx.doi.org/10.1063/1.4939687