

DAVID CZAPLEWSKI

Nanoscience Scientist

Nanofabrication and Devices Group

Center for Nanoscale Materials
Building 440, Room A137
Phone: 630-252-3258
Fax: 630-252-5739
E-mail: dczaplewski@anl.gov

Argonne National Laboratory
9700 S Cass Ave., Argonne, IL 60439



Education

- Ph.D. Applied Physics, Cornell University (2003)
- M. S. Applied Physics, Cornell University (2001)
- B. S. Physics, University of Illinois at Chicago (1998)

Awards and honors

- R&D 100 Award: Sequential Infiltration Synthesis (SIS) Lithography (2014)
- Employee recognition award, “RF MEMS Switch Reliability Team” Sandia National Laboratories (2008)

Research interests

- Design, realization, and characterization of micro- and nano- scaled devices and structures for studying a wide range of scientific topics.
- Studying the non-linear dynamics of M/NEMS resonators and oscillators, including synchronization and modal coupling.
- Studying plasmonic behavior and light scattering, ranging from Rayleigh to Mie, for the formation of metamaterials, including applications such as flat lenses.

Professional Experience

Argonne National Laboratory - Center for Nanoscale Materials (CNM)
Nanoscience Scientist

2009-present

- Design, realization, and characterization of micro- and nano- electromechanical systems (M/NEMS) for studying the non-linear dynamics of M/NEMS resonators and oscillators, including synchronization and modal coupling.
- Design, realization, and characterization of both metallic and dielectric nano-structures for studying plasmonic behavior and light scattering, ranging from Rayleigh to Mie, for the formation of metamaterials, including flat lenses.
- Studying the interaction of high energy electrons with matter

Sandia National Laboratory
Senior Member of the Technical Staff

2005-2009

- Design, fabrication, and characterization of a nanomechanical switch with sub-micron footprint, low actuation voltage, and long lifetime
- Design, fabrication, and characterization of an RF MEMS switch, including optimizing the dynamic response and solving the most important problem of increasing the lifetimes of the switches by preventing fouling of the contacts using new metallurgy

- Study the materials properties and intrinsic loss mechanisms of tetrahedral amorphous carbon through the creation of MEMS and NEMS structures

Selected Publications

1. C. Chen, D. H. Zanette, J. R. Guest, **D. A. Czaplewski**, D. Lopez, "A self-sustained mechanical oscillator with linear feedback", accepted at Phys. Rev. Lett.
2. G. Yang, A. Fragner, G. Koolstra, L. Ocola, **D. A. Czaplewski**, R. J. Schoelkopf, and D. I. Schuster, "Coupling an Ensemble of Electrons on Superfluid Helium to a Superconducting Circuit", Phys. Rev. X **6**, 011031 (2016). Highlighted in Physics reviews: <http://physics.aps.org/articles/v9/31>
3. F. Cheng, X. Yang, D. Rosenmann, L. Stan, **D. Czaplewski**, and J. Gao, "Enhanced structural color generation in aluminum metamaterials coated with a thin polymer layer", Optics Express **23** 243144, (2015).
4. G. Wei, T. K. Stanev, **D. A. Czaplewski**, I. W. Jung, and N. P. Stern, "Silicon-nitride photonic circuits interfaced with monolayer MoS₂", Appl. Phys. Lett. **107** 091112 (2015).
5. B. S. Dennis, **D. A. Czaplewski**, M. I. Haftel, D. Lopez, G. Blumberg and V. Aksyuk, "Diffraction limited focusing and directing of gap plasmons by a metal-dielectric-metal lens", Optics Express **23** pp. 21899-21908 (2015).
6. F. Cheng, J. Gao, L. Stan, D. Rosenmann, **D. Czaplewski**, and X. Yang, "Aluminum plasmonic metamaterials for structural color printing", Optics Express **23** pp. 14552-60 (2015).
7. H. Deng, Z. Li, L. Stan, D. Rosenmann, **D. Czaplewski**, J. Gao, and X. Yang, "Broadband perfect absorber based on one ultrathin layer of refractory metal", Optics Letters **40** pp. 2592-5 (2015).
8. D. Antonio, **D. A. Czaplewski**, J. R. Guest, D. López, S. I. Arroyo and D. H. Zanette, "Nonlinearity-Induced Synchronization Enhancement in Micromechanical Oscillators", Physical Review Letters **114** 034103 (2015).
9. B. S. Dennis, M. I. Haftel, **D. A. Czaplewski**, D. Lopez, G. Blumberg and V. A. Aksyuk, "Compact nanomechanical plasmonic phase modulators", Nature Photonics **9** pp. 267-273 (2015).
10. **D. A. Czaplewski** and L. E. Ocola, "Variation of backscatter electron intensity", JVST **B31** 06F202-1 (2013).
11. X. Yang, C. Hu, H. Deng, D. Rosenmann, **D. A. Czaplewski**, J. Gao, "Experimental demonstration of near-infrared epsilon-near-zero multilayer metamaterial slabs", Optics Express **21** pp. 23631-23639 (2013).
12. **D. A. Czaplewski**, M. V. Holt, and L. E. Ocola, "The range and intensity of backscattered electrons for use in the creation of high fidelity electron beam lithography patterns", Nanotechnology **24** 305302 (2013).
13. **D. A. Czaplewski**, C. D. Nordquist, G. A. Patrizi, G. M. Kraus, and W. D. Cowan, "RF MEMS switches with RuO₂-Au contacts cycled to 10B cycles", J. Microelectromech. Syst. **22** pp. 655-661 (2013).
14. G. Gopalakrishnan, M. V. Holt, K. M. McElhinny, J. W. Spalenka, **D. A. Czaplewski**, T. U. Schüllli, and P. G. Evans, "Thermal diffuse scattering evidence for confined large-wavevector phonon modes in silicon nanomembranes", Phys. Rev. Lett. **110** 205503 (2013).
15. M. Zalazar, P. Gurman, J. Park, D. Kim, S. Hong, L. Stan, R. Divan, **D. Czaplewski** and O. Auciello "Integration of Piezoelectric Aluminum Nitride and Ultrananocrystalline Diamond Films for implantable Biomedical Microelectromechanical Systems" Appl. Phys. Lett. **12** 104101 (2013).

DAVID CZAPLEWSKI

16. G. Gopalakrishnan, **D. A. Czaplewski**, K. M. McElhinny, M. V. Holt, J. C. Silva-Martinez, and P. G. Evans, "Edge-induced flattening in the fabrication of ultrathin freestanding crystalline silicon sheets", *Appl. Phys. Lett.* **102**, 033113 (2013).
17. **D. A. Czaplewski**, C. D. Nordquist, C. W. Dyck, G. A. Patrizi, G. M. Kraus, and W. D. Cowan, "Lifetime limitations of ohmic, contacting RF MEMS switches with Au, Pt, and Ir contact materials due to accumulation of 'friction polymer' on the contacts", *J. Micromech. Microeng.* **22** 105005 (2012).
18. M. P. de Boer, **D. A. Czaplewski**, M. I. S. Baker, S. L. Wolfley, and A. J. Ohlhausen, "Design, Fabrication, Performance, and Reliability of Pt- and RuO₂-coated microrelays tested in ultra-high purity gas environments" *J. of Micromech. Microeng.* **22** 105027 (2012).
19. **D. A. Czaplewski** and L. E. Ocola, "100 keV electron backscattered range and coefficient for silicon" *J. Vac. Sci. Technol. B* **30**, 021604-1, 2011.
20. **D. A. Czaplewski** and L. E. Ocola, "Measurement of backscattered 100 keV electrons on a solid substrate", *Appl. Phys. Lett.* **99**, 192105, 2011.
21. Y. C. Tseng, Q. Peng, L. E. Ocola, **D. A. Czaplewski**, J. W. Elam and S. B. Darling, "Enhanced polymeric lithography resists via sequential infiltration synthesis" *J. Mater. Chem.*, **21**, 11722-11725, 2011.
22. **D. A. Czaplewski**, G. A. Patrizi, G. M. Kraus, J. R. Wendt, C. D. Nordquist, S. L. Wolfley, M. S. Baker and M. P. de Boer, "Nanomechanical switch for integration with CMOS logic", *Journal of Micromechanics and Microengineering*, Vol. 19, article 085003, 2009. (Highlight of 2009: <http://iopscience.iop.org/0960-1317/page/Highlights%20of%202009>)
23. **D. A. Czaplewski**, S. S. Verbridge, J. Kameoka and H. G. Craighead, "Nanomechanical Oscillators Fabricated using Polymeric Nanofiber Templates", *Nano Lett.*, Vol. 4, No. 3, pp. 437-439, 2004.
24. M. Sato, B. E. Hubbard, A. J. Sievers, B. Ilic, **D. A. Czaplewski**, and H. G. Craighead, "Observation of Locked Intrinsic Localized Vibrational Modes in a Micromechanical Oscillator Array", *Phys. Rev. Lett.*, vol. 90, no. 4, pp. 044102-1-4, 2003.
25. B. Ilic, **D. A. Czaplewski**, H. G. Craighead (CU), P. Neuzil (IME), C. Campagnolo, C. Batt (CU), "Mechanical Resonant Immunospecific Biological Detector," *Appl. Phys. Lett.*, vol. 77, no. 3, pp. 450-452, 2000. Applied Physics Letters article was in Science Editors Choice section, *Science*, vol. 289, no. 5479, 2000.

Patents

- Kyle, McElhinny, Paul Evans, Gokul Gopalakrishnan, and David A. Czaplewski, "Fabrication of flat, ultrathin freestanding silicon nanomembranes by edge induced flattening", submitted in conjunction with UW Madison.
- David Czaplewski, Omar Daniel Lopez, Jeffrey R. Guest, "Nonlinearity Induced Synchronization Enhancement in Micromechanical Oscillators" (submitted)
- Changyao Chen, David Czaplewski, Omar Daniel Lopez, "Frequency and Amplitude Stabilization in MEMS and NEMS Oscillators" (submitted)
- Christopher D. Nordquist and David A. Czaplewski, Nanoelectromechanical Switch and Logic Circuits Formed Therefrom, US patent #07719318 issued May 18, 2010.
- Maxim Zalalutdinov; Anatoli Olkhovets; Alan T. Zehnder; Bojan Ilic; David A. Czaplewski; Lidija Sekaric; Jeevak M. Parpia; Harold G. Craighead, Heat pumped parametric MEMS device, US patent #07654140, issued Feb 2, 2010.
- H. G. Craighead, B. Ilic, D. A. Czaplewski, R. H. Hall, High sensitivity mechanical resonant sensor, U.S. patent #07148017, issued Dec. 12, 2006.