

Stanford



Roger Howe

William E. Ayer Professor in Electrical Engineering

 Curriculum Vitae available Online

Bio

BIO

Design and fabrication of sensors and actuators using micro and nanotechnologies, with applications to information processing and energy conversion.

ACADEMIC APPOINTMENTS

- Professor, Electrical Engineering
- Member, Bio-X
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Faculty Director, Stanford Nanofabrication Facility, (2009-2017)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, National Academy of Engineering (2005 - present)

PROFESSIONAL EDUCATION

- PhD, UC Berkeley (1984)

LINKS

- <http://www.stanford.edu/~rhowe/>: <http://www.stanford.edu/~rhowe/>

Teaching

COURSES

2019-20

- Advanced Micro and Nano Fabrication Laboratory: ENGR 241 (Win)
- An Intro to Making: What is EE: ENGR 40M (Spr)
- Introduction to Micro and Nano Electromechanical Systems: ENGR 240 (Aut)

2018-19

- Advanced Micro and Nano Fabrication Laboratory: ENGR 241 (Win)
- An Intro to Making: What is EE: ENGR 40M (Spr)
- An Intro to Making: What is EE: OSPBER 40M (Spr)
- An Intro to Making: What is EE: OSPPARIS 40M (Spr)

- Principles and Models of Semiconductor Devices: EE 216 (Win)

2017-18

- Advanced Micro and Nano Fabrication Laboratory: ENGR 241 (Spr)
- An Intro to Making: What is EE: ENGR 40M (Spr)
- An Intro to Making: What is EE: OSPBER 40M (Spr)
- Principles and Models of Semiconductor Devices: EE 216 (Win)

2016-17

- Advanced Micro and Nano Fabrication Laboratory: ENGR 241 (Aut)
- An Intro to Making: What is EE: ENGR 40M (Spr)
- An Intro to Making: What is EE: OSPBER 40M (Spr)
- Principles and Models of Semiconductor Devices: EE 216 (Win)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

John Bartel, Michelle Chen, Xiyuan Chen, Vlad Kesler, Akash Levy, Punng Padhy, Maryann Tung, Gabrielle Vukasin

Doctoral Dissertation Advisor (AC)

Lina Qiu, Eric Wu

Master's Program Advisor

Joelle Dowling

Doctoral (Program)

Savannah Benbrook, Lina Qiu, Kirstin Schauble, Luke Upton, Sophia Williams, Eric Wu

Publications

PUBLICATIONS

- **Epitaxial silicon microshell vacuum-encapsulated CMOS-compatible 200 MHz bulk-mode resonator**
Chen, K. L., Chandralalim, H., Graham, A. B., Bhavne, S., A., Howe, R. T., Kenny, T., W.
- **Wafer scale encapsulation of large lateral deflection MEMS structures**
Graham, A. B., Messana, M., Hartwell, P., Provine, J., Yoneoka, S., Kim, B., Howe, R. T.
- **Anomalous hysteresis and current fluctuations in cyclic voltammograms at microelectrodes due to Ag leaching from Ag/AgCl reference electrodes** *ELECTROCHEMISTRY COMMUNICATIONS*
Chia, C., Jeffrey, S. S., Howe, R. T.
2019; 105
- **ALD HfO₂ Films for Defining Microelectrodes for Electrochemical Sensing and Other Applications** *ACS APPLIED MATERIALS & INTERFACES*
Chia, C., Shulaker, M. M., Provine, J., Jeffrey, S. S., Howe, R. T.
2019; 11 (29): 26082–92
- **Micron-gap spacers with ultrahigh thermal resistance and mechanical robustness for direct energy conversion** *MICROSYSTEMS & NANOENGINEERING*
Nicaise, S. M., Lin, C., Azadi, M., Bozorg-Grayeli, T., Adebayo-Ige, P., Lilley, D. E., Pfitzer, Y., Cha, W., Van Houten, K., Melosh, N. A., Howe, R. T., Schwede, J. W., Bargatin, et al
2019; 5
- **Photonic crystal mirrors for free-space communication and fiber-optic sensors**
Hadzialic, S., Jung, I., W., Kilic, O., Kim, S., Provine, J., Howe, R., T.

- **Quantum Tunneling Currents in a Nanoengineered Electrochemical System** *JOURNAL OF PHYSICAL CHEMISTRY C*
Gupta, C., Walker, R. M., Chang, S., Fischer, S. R., Seal, M., Murmann, B., Howe, R. T.
2017; 121 (28): 15085–105
- **Three-dimensional integration of nanotechnologies for computing and data storage on a single chip** *NATURE*
Shulaker, M. M., Hills, G., Park, R. S., Howe, R. T., Saraswat, K., Wong, H., Mitra, S.
2017; 547 (7661): 74+
- **Back-end-of-line compatible Poly-SiGe lateral nanoelectromechanical relays with multi-level interconnect**
Harrison, K. L., Clary, W. A., Provine, J., Howe, R. T.
SPRINGER.2017: 2125–30
- **Fully differential interal electrostatic transduction of a Lamé-mode resonator**
Ziaei-Moayyed, M., Elata, D., Hsieh, J., Chen, J., W., Quévy, E., P., Howe, R., T.
- **Back-gated graphene anode for more efficient thermionic energy converters** *NANO ENERGY*
Yuan, H., Riley, D. C., Shen, Z., Pianetta, P. A., Melosh, N. A., Howe, R. T.
2017; 32: 67-72
- **Active control of probability amplitudes in a mesoscale system via feedback-induced suppression of dissipation and noise** *JOURNAL OF APPLIED PHYSICS*
Gupta, C., Perez, A. P., Fischer, S. R., Weinreich, S. B., Murmann, B., Howe, R. T.
2016; 120 (22)
- **A Super Stretchable Organic Thin-Film Diodes Network That Can Be Embedded Into Carbon Fiber Composite Materials for Sensor Network Applications** *JOURNAL OF MICROELECTROMECHANICAL SYSTEMS*
Guo, Z., Aboudi, U., Peumans, P., Howe, R. T., Chang, F.
2016; 25 (3): 524-532
- **Electropermanent magnet actuation for droplet ferromicrofluidics.** *Technology*
Padovani, J. I., Jeffrey, S. S., Howe, R. T.
2016; 4 (2): 110-119
- **Design and fabrication of silicon-tessellated structures for monocentric imagers** *MICROSYSTEMS & NANOENGINEERING*
Wu, T., Hamann, S. S., Ceballos, A. C., Chang, C., Solgaard, O., Howe, R. T.
2016; 2
- **Stable Encapsulated Charge-Biased Resonators** *JOURNAL OF MICROELECTROMECHANICAL SYSTEMS*
Ng, E. J., Harrison, K. L., Yang, Y., Ahn, C. H., Hong, V. A., Howe, R. T., Kenny, T. W.
2016; 25 (1): 30-37
- **Design and fabrication of silicon-tessellated structures for monocentric imagers.** *Microsystems & nanoengineering*
Wu, T., Hamann, S. S., Ceballos, A. C., Chang, C. E., Solgaard, O., Howe, R. T.
2016; 2: 16019
- **Engineering Ultra-Low Work Function of Graphene** *NANO LETTERS*
Yuan, H., Chang, S., Bargatin, I., Wang, N. C., Riley, D. C., Wang, H., Schwede, J. W., Provine, J., Pop, E., Shen, Z., Pianetta, P. A., Melosh, N. A., Howe, et al
2015; 15 (10): 6475-6480
- **Thermionic and photon-enhanced emission energy conversion**
Melosh, N., Riley, D., Sahasrabudde, K., Shen, Z. X., Schwede, J., Howe, R.
AMER CHEMICAL SOC.2015
- **Partitioning Electrostatic and Mechanical Domains in Nanoelectromechanical Relays** *JOURNAL OF MICROELECTROMECHANICAL SYSTEMS*
Shavezipur, M., Harrison, K., Lee, W. S., Mitra, S., Wong, H. P., Howe, R. T.
2015; 24 (3): 592-598
- **Tunable control of antibody immobilization using electric field.** *Proceedings of the National Academy of Sciences of the United States of America*
Emaminejad, S., Javanmard, M., Gupta, C., Chang, S., Davis, R. W., Howe, R. T.
2015; 112 (7): 1995-1999

- **Integrated atomistic chemical imaging and reactive force field molecular dynamic simulations on silicon oxidation** *APPLIED PHYSICS LETTERS*
Dumpala, S., Broderick, S. R., Khalilov, U., Neyts, E. C., van Duin, A. C., Provine, J., Howe, R. T., Rajan, K.
2015; 106 (1)
- **Polyether Ether Ketone (PEEK) Fluidic Cell to Study Electrochemistry of Microelectrodes on Silicon Substrate** *ECS SOLID STATE LETTERS*
Arun, A., Gupta, C., Howe, R.
2015; 4 (10): P67-P71
- **Microfabricated Thermally Isolated Low Work-Function Emitter** *JOURNAL OF MICROELECTROMECHANICAL SYSTEMS*
Lee, J., Bargatin, I., Vancil, B. K., Gwinn, T. O., Maboudian, R., Melosh, N. A., Howe, R. T.
2014; 23 (5): 1182-1187
- **Inherent Enhancement of Electronic Emission from Hexaboride Heterostructure** *PHYSICAL REVIEW APPLIED*
Voss, J., Vojvodic, A., Chou, S. H., Howe, R. T., Abild-Pedersen, F.
2014; 2 (2)
- **Improved Performance of Bottom-Contact Organic Thin-Film Transistor Using Al Doped HfO₂ Gate Dielectric** *IEEE TRANSACTIONS ON ELECTRON DEVICES*
Tang, W. M., Aboudi, U., Provine, J., Howe, R. T., Wong, H. P.
2014; 61 (7): 2398-2403
- **Optical MEMS: From Micromirrors to Complex Systems** *JOURNAL OF MICROELECTROMECHANICAL SYSTEMS*
Solgaard, O., Godil, A. A., Howe, R. T., Lee, L. P., Peter, Y., Zappe, H.
2014; 23 (3): 517-538
- **DFT Study of Atomically-Modified Alkali-Earth Metal Oxide Films on Tungsten** *JOURNAL OF PHYSICAL CHEMISTRY C*
Chou, S. H., Voss, J., Vojvodic, A., Howe, R. T., Abild-Pedersen, F.
2014; 118 (21): 11303-11309
- **Double-Layer Silicon Photonic Crystal Fiber-Tip Temperature Sensors** *IEEE PHOTONICS TECHNOLOGY LETTERS*
Park, B., Jung, I. W., Provine, J., Gellineau, A., Landry, J., Howe, R. T., Solgaard, O.
2014; 26 (9): 900-903
- **Depletion of cells and abundant proteins from biological samples by enhanced dielectrophoresis** *17th International Conference on Solid-State Sensors, Actuators and Microsystems*
Javanmard, M., Emaminejad, S., Gupta, C., Provine, J., Davis, R. W., Howe, R. T.
ELSEVIER SCIENCE SA.2014: 918-24
- **Analysis of Asperity Dominated Contacts in Nanoelectromechanical Relays Using Thin Films**
Harrison, K. L., Dalvi, C., Ashghi, M., Howe, R. T., IEEE
IEEE.2014: 1256-60
- **STABLE CHARGE-BIASED CAPACITIVE RESONATORS WITH ENCAPSULATED SWITCHES**
Ng, E. J., Harrison, K. L., Everhart, C. L., Hong, V. A., Yang, Y., Ahn, C., Heinz, D. B., Howe, R. T., Kenny, T. W., IEEE
IEEE.2014: 1277-80
- **Vacuum encapsulated resonators for humidity measurement** *SENSORS AND ACTUATORS B-CHEMICAL*
Hennessy, R. G., Shulaker, M. M., Messana, M., Graham, A. B., Klejwa, N., Provine, J., Kenny, T. W., Howe, R. T.
2013; 185: 575-581
- **Laterally Actuated Platinum-Coated Polysilicon NEM Relays** *JOURNAL OF MICROELECTROMECHANICAL SYSTEMS*
Parsa, R., Lee, W. S., Shavezipur, M., Provine, J., Maboudian, R., Mitra, S., Wong, H. P., Howe, R. T.
2013; 22 (3): 768-778
- **Thermionic current densities from first principles.** *journal of chemical physics*
Voss, J., Vojvodic, A., Chou, S. H., Howe, R. T., Bargatin, I., Abild-Pedersen, F.
2013; 138 (20): 204701-?
- **Thermionic current densities from first principles.** *journal of chemical physics*
Voss, J., Vojvodic, A., Chou, S. H., Howe, R. T., Bargatin, I., Abild-Pedersen, F.

2013; 138 (20): 204701-?

- **Combinational Logic Design Using Six-Terminal NEM Relays** *IEEE TRANSACTIONS ON COMPUTER-AIDED DESIGN OF INTEGRATED CIRCUITS AND SYSTEMS*
Lee, D., Lee, W. S., Chen, C., Fallah, F., Provine, J., Chong, S., Watkins, J., Howe, R. T., Wong, H. P., Mitra, S.
2013; 32 (5): 653-666
- **Photon-enhanced thermionic emission from heterostructures with low interface recombination.** *Nature communications*
Schwede, J. W., Sarmiento, T., NARASIMHAN, V. K., Rosenthal, S. J., Riley, D. C., Schmitt, F., Bargatin, I., Sahasrabudhe, K., Howe, R. T., Harris, J. S., Melosh, N. A., Shen, Z.
2013; 4: 1576-?
- **SUB-10 NANOMETER UNCOOLED PLATINUM BOLOMETERS VIA PLASMA ENHANCED ATOMIC LAYER DEPOSITION**
Purkl, F., English, T., Yama, G., Provine, J., Samarao, A. K., Feyh, A., O'Brien, G., Ambacher, O., Howe, R. T., Kenny, T. W., IEEE
IEEE.2013: 185-88
- **Photon-enhanced thermionic emission from heterostructures with low interface recombination.** *Nature communications*
Schwede, J. W., Sarmiento, T., NARASIMHAN, V. K., Rosenthal, S. J., Riley, D. C., Schmitt, F., Bargatin, I., Sahasrabudhe, K., Howe, R. T., Harris, J. S., Melosh, N. A., Shen, Z.
2013; 4: 1576-?
- **Dual-beam six-terminal nanoelectromechanical relays**
Harrison, K., L., Lee, W., S., Shavezipur, K., Provine, J., Mitra, S., Wong, H., S. P., Howe, R. T.
2013
- **Engineering an electrochemical sensor for the characterization of bond vibration frequencies of a chemical analyte.**
Gupta, C., Chang, S., Howe, R., T.
2013
- **Serpentine geometry for enhanced performance of nanometer-thin platinum bolometers**
Purkl, F., English, T., S., Yama, G., Provine, J., Samarao, A., Feyh, A., Howe, R. T.
2013
- **Ultra-thin atomic layer deposition films for corrosion resistance**
Haemmerli, A., J., Doll, J., C., Provine, J., Howe, R., T., Goldhaber-Gordon, D., Pruitt, B., L.
2013
- **Immobilization of antibodies on solid-state surfaces with controlled orientation using electric field**
Javanmard, M., Emaminejad, S., Gupta, C., Chang, S., Davis, R., W., Howe, R., T.
2013
- **Three stage sample preparation for purification of proteins from complex biological samples** *IEEE Sensors 2013, Baltimore, Maryland*
Javanmard, M., Emaminejad, S., Davis, R., W., Gupta, C., Howe, R., T.
2013: 1-4
- **Applications of nanonewton dielectrophoresis forces using atomic layer deposited oxides for microfluidic sample preparation and proteomics**
Emaminejad, S., Javanmard, M., Gupta, C., Dutton, R., W., Davis, R., W., Howe, R., T.
2013
- **Ultra dielectrophoresis: electrothermal analysis and its applications in microfluidic sample preparation and proteomics**
Emaminejad, S., Javanmard, M., Gupta, C., Davis, R., W., Howe, R., T.
2013
- **Capacitive Accelerometer Laboratory Using Polymer-Film Rapid Prototyping Technology** *3rd Interdisciplinary Engineering Design Education Conference (IEDEC)*
Gellineau, A. A., Rastegar, A. J., Howe, R. T.
IEEE.2013: 79-82
- **Microbead-separated thermionic energy converter with enhanced emission current** *PHYSICAL CHEMISTRY CHEMICAL PHYSICS*
Littau, K. A., Sahasrabudhe, K., Barfield, D., Yuan, H., Shen, Z., Howe, R. T., Melosh, N. A.
2013; 15 (34): 14442-14446

- **LATERALLY ACTUATED NANO-ELECTROMECHANICAL RELAYS WITH COMPLIANT, LOW RESISTANCE CONTACT** *26th IEEE International Conference on Micro Electro Mechanical Systems (MEMS)*
Shavezipur, M., Lee, W. S., Harrison, K. L., Provine, J., Mitra, S., Wong, H. P., Howe, R. T.
IEEE.2013: 520–523
- **An orbital-overlap model for minimal work functions of cesiated metal surfaces** *JOURNAL OF PHYSICS-CONDENSED MATTER*
Chou, S. H., Voss, J., Bargatin, I., Vojvodic, A., Howe, R. T., Abild-Pedersen, F.
2012; 24 (44)
- **A model for emission yield from planar photocathodes based on photon-enhanced thermionic emission or negative-electron-affinity photoemission** *JOURNAL OF APPLIED PHYSICS*
Sahasrabudde, K., Schwede, J. W., Bargatin, I., Jean, J., Howe, R. T., Shen, Z., Melosh, N. A.
2012; 112 (9)
- **Control of DNA Capture by Nanofluidic Transistors** *ACS NANO*
Paik, K., Liu, Y., Tabard-Cossa, V., Waugh, M. J., Huber, D. E., Provine, J., Howe, R. T., Dutton, R. W., Davis, R. W.
2012; 6 (8): 6767-6775
- **Microencapsulation of silicon cavities using a pulsed excimer laser** *JOURNAL OF MICROMECHANICS AND MICROENGINEERING*
Sedky, S., Tawfik, H., Ashour, M., Graham, A. B., Provine, J., Wang, Q., Zhang, X. X., Howe, R. T.
2012; 22 (7)
- **Smart-cut layer transfer of single-crystal SiC using spin-on-glass** *JOURNAL OF VACUUM SCIENCE & TECHNOLOGY B*
Lee, J., Bargatin, I., Park, J., Milaninia, K. M., Theogarajan, L. S., Sinclair, R., Howe, R. T.
2012; 30 (4)
- **Single crystal silicon nanopillars, nanoneedles and nanoblades with precise positioning for massively parallel nanoscale device integration** *NANOTECHNOLOGY*
Roper, C. S., Gutes, A., Carraro, C., Howe, R. T., Maboudian, R.
2012; 23 (22)
- **A dry wafer-reconstitution process with zero insertion force by embedded alignment guide tabs** *JOURNAL OF MICROMECHANICS AND MICROENGINEERING*
Chen, J. P., Provine, J., Klejwa, N., Howe, R. T.
2012; 22 (6)
- **A micromachining-based technology for enhancing germanium light emission via tensile strain** *NATURE PHOTONICS*
Jain, J. R., Hryciw, A., Baer, T. M., Miller, D. A., Brongersma, M. L., Howe, R. T.
2012; 6 (6): 398-405
- **Optimal emitter-collector gap for thermionic energy converters** *APPLIED PHYSICS LETTERS*
Lee, J., Bargatin, I., Melosh, N. A., Howe, R. T.
2012; 100 (17)
- **Application of principal component analysis to a full profile correlative analysis of FTIR spectra** *SURFACE AND INTERFACE ANALYSIS*
Broderick, S. R., Suh, C., Provine, J., Roper, C. S., Maboudian, R., Howe, R. T., Rajan, K.
2012; 44 (3): 365-371
- **Electrical and Thermal Conduction in Atomic Layer Deposition Nanobridges Down to 7 nm Thickness** *NANO LETTERS*
Yoneoka, S., Lee, J., Liger, M., Yama, G., Kodama, T., Gunji, M., Provine, J., Howe, R. T., Goodson, K. E., Kennyt, T. W.
2012; 12 (2): 683-686
- **Integration of Nanoelectromechanical Relays With Silicon nMOS** *IEEE TRANSACTIONS ON ELECTRON DEVICES*
Chong, S., Lee, B., Mitra, S., Howe, R. T., Wong, H. P.
2012; 59 (1): 255-258
- **Nano-Electro-Mechanical Relays for FPGA Routing: Experimental Demonstration and a Design Technique**
Chen, C., Lee, W., Parsa, R., Chong, S., Provine, J., Watt, J., Howe, R. T., Wong, H., Mitra, S., IEEE
IEEE.2012: 1361–66

- **CVD hafnium diboride as a contact material for nano-electromechanical switches**
Lee, W., S., Cloud, A., N., Provine, J., Tayebi, N., Parsa, R., Mitra, S., Howe, R. T.
2012
- **Nano-electro-mechanical relays for FPGA routing: experimental demonstration and a design technique**
Chen, C., Lee, W., S., Parsa, R., Chong, S., Provine, J., Watt, J., Howe, R. T.
2012
- **Encapsulated thermionic energy converter with stiffened suspension**
Lee, J., H., Bargatin, I., Iwami, K., Littau, K., A., Vincent, M., Maboudian, R., Howe, R. T.
2012
- **Sidewall silicon carbide emitters for terahertz vacuum electronics**
Snapp, J., P., Lee, J., H., Provine, J., Bargatin, I., Maboudian, R., Lee, T., H., Howe, R. T.
2012
- **Electrochemical quantum tunneling for electronic detection and characterization of biological toxins**
Gupta, C., Walker, R., M., Gharpuray, R., Shulaker, M., M., Zhang, Z., Javanmard, M., Howe, R. T.
2012
- **Multiband charge-coupled device**
Chang, C., E., Siegel, J., D., Kenney, C., J., Roodman, A., J., Howe, R., T.
2012
- **Smart-cut layer transfer of single-crystal SiC using spin-on-glass** *J. Vacuum Sci. Tech. B: Microelectronics and Nanometer Structures*
Lee, J., H., Bargatin, I., Park, J., Milaninia, K., M., Theogarajan, L., S., Sinclair, R., Howe, R. T.
2012; 30: 42001
- **Multiband Charge-Coupled Device** *IEEE Nuclear Science Symposium / Medical Imaging Conference Record (NSS/MIC) / 19th Room-Temperature Semiconductor X-ray and Gamma-ray Detector Workshop*
Chang, C., Segal, J. D., Roodman, A. J., Howe, R. T., Kenney, C. J.
IEEE.2012: 743–746
- **Electrochemical quantum tunneling for electronic detection and characterization of biological toxins** *Conference on Micro- and Nanotechnology Sensors, Systems, and Applications IV*
Gupta, C., Walker, R. M., Gharpuray, R., Shulaker, M. M., Zhang, Z., Javanmard, M., Davis, R. W., Murmann, B., Howe, R. T.
SPIE-INT SOC OPTICAL ENGINEERING.2012
- **Nano-Electro-Mechanical (NEM) Relays and their Application to FPGA Routing** *17th Asia and South Pacific Design Automation Conference (ASP-DAC)*
Chen, C., Lee, S., Provine, J., Chong, S., Parsa, R., Lee, D., Howe, R. T., Wong, H. P., Mitra, S.
IEEE.2012: 639–639
- **MICROFABRICATED SILICON CARBIDE THERMIONIC ENERGY CONVERTER FOR SOLAR ELECTRICITY GENERATION** *25th IEEE International Conference on Micro Electro Mechanical Systems (MEMS)*
Lee, J. H., Bargatin, I., Gwinn, T. O., Vincent, M., Littau, K. A., Maboudian, R., Shen, Z., Melosh, N. A., Howe, R. T.
IEEE.2012
- **Electrical Properties of CuPc-based OTFTs with Atomic Layer Deposited HfAlO Gate Dielectric** *8th IEEE International Conference on Electron Devices and Solid State Circuit (EDSSC)*
Tang, W. M., Aboudi, U., Provine, J., Howe, R. T., Wong, H. P.
IEEE.2012
- **Double-Layer Silicon Photonic Crystal Fiber Tip Temperature Sensor** *25th IEEE Photonics Conference (IPC)*
Park, B., Jung, I. W., Provine, J., Howe, R. T., Solgaard, O.
IEEE.2012: 550–551
- **Photonic Crystal Fiber Tip Sensor for High-Temperature Measurement** *IEEE SENSORS JOURNAL*
Park, B., Provine, J., Jung, I. W., Howe, R. T., Solgaard, O.
2011; 11 (11): 2643-2648

- **Tensile-strained germanium-on-insulator substrate fabrication for silicon-compatible optoelectronics** *OPTICAL MATERIALS EXPRESS*
Jain, J. R., Ly-Gagnon, D., Balram, K. C., White, J. S., Brongersma, M. L., Miller, D. A., Howe, R. T.
2011; 1 (6): 1121-1126
- **Multilayered Monolithic Silicon Photonic Crystals** *IEEE PHOTONICS TECHNOLOGY LETTERS*
Mallick, S. B., Jung, I. W., Meisner, A. M., Provine, J., Howe, R. T., Solgaard, O.
2011; 23 (11): 730-732
- **Highly Sensitive Monolithic Silicon Photonic Crystal Fiber Tip Sensor for Simultaneous Measurement of Refractive Index and Temperature** *JOURNAL OF LIGHTWAVE TECHNOLOGY*
Jung, I. W., Park, B., Provine, J., Howe, R. T., Solgaard, O.
2011; 29 (9): 1367-1374
- **AC Polarization for Charge-Drift Elimination in Resonant Electrostatic MEMS and Oscillators** *JOURNAL OF MICROELECTROMECHANICAL SYSTEMS*
Bahl, G., Salvia, J. C., Melamud, R., Kim, B., Howe, R. T., Kenny, T. W.
2011; 20 (2): 355-364
- **Wafer-Level Epitaxial Silicon Packaging for Out-of-Plane RF MEMS Resonators with Integrated Actuation Electrodes** *IEEE TRANSACTIONS ON COMPONENTS PACKAGING AND MANUFACTURING TECHNOLOGY*
Chen, K., Wang, S., Salvia, J. C., Melamud, R., Howe, R. T., Kenny, T. W.
2011; 1 (3): 310-317
- **Electromechanical Sensing of Charge Retention on Floating Electrodes** *JOURNAL OF MICROELECTROMECHANICAL SYSTEMS*
Elata, D., Leus, V., Provine, J., Hirshberg, A., Howe, R. T.
2011; 20 (1): 150-156
- **Magnetic, Mechanical, and Optical Characterization of a Magnetic Nanoparticle-Embedded Polymer for Microactuation** *JOURNAL OF MICROELECTROMECHANICAL SYSTEMS*
Tsai, K. L., Ziaei-Moayyed, M., Candler, R. N., Hu, W., Brand, V., Klejwa, N., Wang, S. X., Howe, R. T.
2011; 20 (1): 65-72
- **NANOELECTROMECHANICAL RELAYS WITH DECOUPLED ELECTRODE AND SUSPENSION** *24th IEEE International Conference on Micro Electro Mechanical Systems (MEMS)*
Parsa, R., Shavezpur, M., Lee, W. S., Chong, S., Lee, D., Wong, H. P., Maboudian, R., Howe, R. T.
IEEE.2011: 1361-1364
- **A reel-to-reel printed accelerometer**
Klejwa, N., Hennessy, R., G., Chen, J., W. P., Howe, R., T.
2011
- **Low thermal-budget silicon sealed-cavity microencapsulation process**
Sedky, S., Tawfik, H., Aziz, A., Abdel, ElSaegh, S., Graham, A., B., Provine, J., Howe, R. T.
2011
- **Spacer technique for low-voltage, high-aspect-ratio lateral electrostatic actuators**
Lee, D., Mitra, S., Howe, R., T., Wong, H., S. P.
2011
- **Vacuum microsystems for energy conversion and other applications**
Howe, R., T.
2011
- **Atomic layer deposition of Al₂O₃ to protect carbon nanotubes for integration with top-down fabrication**
Shulaker, M., M., Provine, J., Howe, R., T., Mitra, S.
2011
- **Effect of illumination on thermionic emission of microfabricated silicon carbide structures**
Lee, J., H., Bargatin, I., Provine, J., Liu, F., Seo, M., K., Maboudian, R., Howe, R. T.
2011

- **Dual sidewall lateral nanoelectromechanical relays with beam isolation**
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