Stanford

Roger Howe

William E. Ayer Professor of Electrical Engineering, Emeritus

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

- Emeritus Faculty, Acad Council, Electrical Engineering
- Member, Bio-X
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Acting Faculty Director, Stanford Nanofabrication Facility, (2020-2021)
- 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

- https://web.stanford.edu/~rthowe/: https://web.stanford.edu/~rthowe/

Teaching

COURSES

2024-25

- An Intro to Making: What is EE: OSPBER 40M (Aut)
- Introduction to Micro and Nano Electromechanical Systems: ENGR 240 (Win)

2023-24

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

2022-23

- An Intro to Making: What is EE: OSPBER 40M (Aut, Win, Spr)

- Integrated Circuit Fabrication Laboratory: EE 312 (Win)
- Introduction to Micro and Nano Electromechanical Systems: ENGR 240 (Win)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Jillian Anderson, Kai Chang, Sergio Cordero, Jasmine Cox, Wei Ren

Doctoral (Program)

Michelle Hedlund, Zahra Heussen, Hannah Lee, Favour Nerrise, Allan Raventos Knohr

Publications

PUBLICATIONS

- **"Deep approaches to learning" in a project-based nanofabrication graduate course** *JOURNAL OF THE SOCIETY FOR INFORMATION DISPLAY*
  Tang, M., Kommera, S., Raghuram, U., Rincon, M., Xu, X., Fan, J., Howe, R. T.
  2022
- **Optimized Deep Reactive-Ion Etching of Nanostructured Black Silicon for High-Contrast Optical Alignment Marks** *ACS APPLIED NANO MATERIALS*
  Yusuf, M., Herring, G. K., Neustock, L., Zaman, M., Raghuram, U., Narasimhan, V. K., Chia, C., Howe, R. T.
  2021; 4 (7): 7047-7061
- **Encapsulated Cell Dynamics in Droplet Microfluidic Devices with Sheath Flow.** *Micromachines*
  Beshay, P. E., Ibrahim, A. M., Jeffrey, S. S., Howe, R. T., Anis, Y. H.
  2021; 12 (7)
- **Interpretable Classification of Bacterial Raman Spectra with Knockoff Wavelets.** *IEEE journal of biomedical and health informatics*
  Chia, C., Sesia, M., Ho, C. S., Jeffrey, S. S., Dionne, J. A., Candes, E., Howe, R. T.
  2021; PP
- **Encapsulated Cell Dynamics in Droplet Microfluidic Devices with Sheath Flow** *MICROMACHINES*
  Beshay, P. E., Ibrahim, A. M., Jeffrey, S. S., Howe, R. T., Anis, Y. H.
  2021; 12 (7)
- **Modeling of Droplet Generation in a Microfluidic Flow-Focusing Junction for Droplet Size Control.** *Micromachines*
  Ibrahim, A. M., Padovani, J. I., Howe, R. T., Anis, Y. H.
  2021; 12 (6)
- **Electropermanent magnet-driven droplet size modulation for two-phase ferromicrofluidics** *MICROFLUIDICS AND NANOFLUIDICS*
  Padovani, J., Ibrahim, A. M., Jeffrey, S. S., Anis, Y. H., Howe, R. T.
  2020; 24 (12)
- **A vibrating beam MEMS accelerometer for gravity and seismic measurements.** *Scientific reports*
  Mustafazade, A., Pandit, M., Zhao, C., Sobreviela, G., Du, Z., Steinmann, P., Zou, X., Howe, R. T., Seshia, A. A.
  2020; 10 (1): 10415
- **Neural network-based model of photoresist reflow** *JOURNAL OF VACUUM SCIENCE & TECHNOLOGY B*
  Chia, C., Martis, J., Jeffrey, S. S., Howe, R. T.
  2019; 37 (6)
- **Surface Photovoltage-Induced Ultralow Work Function Material for Thermionic Energy Converters** *ACS ENERGY LETTERS*
  Schindler, P., Riley, D. C., Bargatin, I., Sahasrahuddhe, K., Schwede, J. W., Sun, S., Pianetta, P., Shen, Z., Howe, R. T., Melosh, N. A.
  2019; 4 (10): 2436–43
- **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: 31

- **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
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- **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.
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  Shulaker, M. M., Hills, G., Park, R. S., Howe, R. T., Saraswat, K., Wong, H., Mitra, S.
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- **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.
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- **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.
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- **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. E., Solgaard, O., Howe, R. T.
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- **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.
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- **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.
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- **Engineering Ultra-Low Work Function of Graphene** *NANO LETTERS*
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- **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.
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- **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.
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- **Polyether Ether Ketone (PEEK) Fluidic Cell to Study Electrochemistry of Microelectrodes on Silicon Substrate** *ECS SOLID STATE LETTERS*
  Arun, A., Gupta, C., Howe, R.
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- **Microfabricated Thermally Isolated Low Work-Function Emitter** *JOURNAL OF MICROELECTROMECHANICAL SYSTEMS*
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- **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.
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- **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.
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- **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.
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- **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.
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- **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.
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- **Analysis of Asperity Dominated Contacts in Nanoelectromechanical Relays Using Thin Films**
  Harrison, K. L., Dalvi, C., Asheghi, M., Howe, R. T., IEEE

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- **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
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- **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.
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- **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.
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- **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.
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  Schwede, J. W., Sarmiento, T., NARASIMHAN, V. K., Rosenthal, S. J., Riley, D. C., Schmitt, F., Bargatin, I., Sahasrabuddhe, K., Howe, R. T., Harris, J. S., Melosh, N. A., Shen, Z.
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- **Applications of nanonewton dielectrophoresis forces using atomic layer deposted oxides for microfluidic sample preparation and proteomics**
  Emaminejad, S., Javanmard, M., Gupta, C., Dutton, R., W., Davis, R., W., Howe, R., T.
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- **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., Sahasrabuddhe, K., Barfield, D., Yuan, H., Shen, Z., Howe, R. T., Melosh, N. A.
  2013; 15 (34): 14442-14446
- **LATERALLY ACTUATED NANOELECTROMECHANICAL 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
- **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., Emaminjad, S., Gupta, C., Chang, S., Davis, R., W., Howe, R., T.

2013

- **Three stage sample preparation for purificaiton of proteins from complex biological samples** *IEEE Sensors 2013, Baltimore, Maryland*
  Javanmard, M., Emaminejad, S., Davis, R., W., Gupta, C., Howe, R., T.
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- **Applications of nanonewton dielectrophoresis forces using atomic layer deposted oxides for microfluidic sample preparation and proteomics**
  Emaminejad, S., Javanmard, M., Gupta, C., Dutton, R., W., Davis, R., W., Howe, R., T.
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- **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.
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- **An orbital-overlap model for minimal work functions of cesiated metal surfaces** *JOURNAL OF PHYSICS-CONDENSED MATTER*
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  Sahasrabuddhe, K., Schwede, J. W., Bargatin, I., Jean, J., Howe, R. T., Shen, Z., Melosh, N. A.
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- **Single crystal silicon nanopillars, nanoneedles and nanoblades with precise positioning for massively parallel nanoscale device integration** *NANOTECHNOLOGY*
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- **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.
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- **Application of principal component analysis to a full profile correlative analysis of FTIR spectra** *SURFACE AND INTERFACE ANALYSIS*
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- **Electrical and Thermal Conduction in Atomic Layer Deposition Nanobridges Down to 7 nm Thickness** *NANO LETTERS*
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- **Integration of Nanoelectromechanical Relays With Silicon nMOS** *IEEE TRANSACTIONS ON ELECTRON DEVICES*
  Chong, S., Lee, B., Mitra, S., Howe, R. T., Wong, H. P.
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- **Nano-Electro-Mechanical Relays for FPGA Routing: Experimental Demonstration and a Design Technique**
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  Lee, J., H., Bargatin, I., Iwami, K., Littau, K., A., Vincent, M., Maboudian, R., Howe, R. T.
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  Lee, J., H., Bargatin, Igor, I., Park, J., Milaninia, K., M., Theogarajan, L., S., Sinclair, R., Howe, R. T.
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- **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.
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  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)*
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- **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.
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- **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.
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- **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.
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