

## Thomas W. Kenny

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### Education

- University of California, Berkeley  
Ph D Physics June 1989
- University of Minnesota, Minneapolis  
BS Physics March 1983

### Experience

**Senior Associate Dean of Engineering for Student Affairs, Stanford. 7/15-present.**

**Founder, Member Board of Directors, Applaud Medical 11/14-present.**

- Non-invasive therapy for Kidney Stones

**Founder, Member, Board of Directors, Chair of Technical Advisory Board, SiTime 8/04-11/14**

- CMOS-Compatible MEMS Resonators for Electronic Products.

**CTO and Founder Cooligy, 6/02-3/05**

- Liquid cooling of microprocessors and other high power-density electronic devices.

**Program Manager, DARPA Microsystems Technology Office, 10/06-10/10**

- Launched \$250M program on Nanotechnology, Thermal Management and Nanomanufacturing.

**Professor, Department of Mechanical Engineering, Stanford University, 1/94-Present**

- Leading Micromechanical Systems Research Group, with emphasis on development of high-performance microsensors, and measurements of fundamental properties of microstructures.
- Active research in Micromechanical Resonators for Time References, Encapsulated Inertial Sensors, Optimal Design of MEMS Structures, Wafer-Scale Packaging of MEMS Devices.
- Teaching Mechatronics, Sensors and Measurement, and others

**Staff Scientist, Technical Group Leader, Jet Propulsion Laboratory, 7/89-1/94.**

- Led the design, construction, and characterization of novel micromachined Si infrared detectors magnetometers and accelerometers based on an electron tunneling displacement transducer. Fully packaged tunneling sensors were delivered to collaborators for characterization.
- Participated in development of meteorological instrumentation (pressure, wind, temperature, humidity,...), seismological instrumentation, deformable optical elements, instrumented neurological probes, soil chemistry apparatus, calibration parts for space telescopes,...

**Research Assistant, Physics Department, University of California, Berkeley. 1/84-7/89.**

- Measured of the heat capacity of  $^4\text{He}$  submonolayers on metallic films, showing them to be in a 2-dimensional Bose gas phase, in contradiction to similar measurements on other substrates.

### Honors

- Recipient Stanford Presidential Award for Excellence in Diversity 6/19
- Recipient Tau Beta Pi Teaching Honor Roll 6/19
- Recipient IEEE Daniel Noble Award for Emerging Technologies 9/18
- Recipient IEEE Sensors Council Technical Achievement Award 9/11
- Winner Coed Ultimate Frisbee National and World Champion 11/98, 11/99
- Recipient NSF CAREER Award 7/95
- Recipient Terman Fellowship 7/94
- Recipient R+D 100 Award 5/93
- Recipient Distinguished Teaching Award 6/89
- Recipient AT&T Bell Laboratories Fellowship 8/86-6/89

## Litigation Experiences

- 2019 retained as Expert witness in case related to wearable baby monitors, including motion and temperature sensors. Case settled during drafting of expert infringement report.
- 2018, retained as Expert witness by attorneys representing Apple in a case related to algorithms for sensing motion and other physiological parameters in wearable devices,. Case settled after going on hold for IPR evaluation of IP.
- 2016, Expert Witness in case involving optical proximity sensors in smartphones. I was retained by HTC America and Capella, who were defendants in the case. I was compensated by defendants for work involving Invalidity and Non-Infringement reports, and was deposed after expert reports on invalidity and non-infringement. This case settled just a few weeks before trial in march 2017. This was Case Action No. 2:15-cv-1524-JRG in Marshall Texas.
- 2015, Expert Witness in Mayfonk –vs- Nike patent infringement suit brought by Mayfonk. I prepared expert reports on validity and non-infringement. The case settled just before depositions were taken. I was compensated by Nike for this work. This was case # Civil No.3:14-cv-00423-MO in the District of Oregon.
- 2013-2014, Expert Witness in ST Microelectronics –vs- Invensense patent infringement suit brought by ST. I assisted in claim construction, prepared expert reports on claim construction, validity and infringement, and provided deposition testimony. I was compensated by Invensense for this work. This was ITC Investigation # 337-TA-876.
- 2011-2012, Expert Witness in St. Jude Medical-vs-Volcano Corp patent infringement suit and counter suit. Assisted in claim construction, prepared expert reports, provided deposition testimony and trial testimony. I was compensated by Volcano Corporation for this work.
- 2011, Retained by Maxim Integrated Systems to examine documents and prepare opinions as to the value of certain documents in the possession of former employees of ST Microelectronics. I was compensated by Maxim for this work. This was Italian proceeding Rg. 50253/2011.

## Books :

J.E. Carryer, M.Ohline and T.W. Kenny, "Introduction to Mechatronic Design", Pearson (2011).

## Refereed Journal Publications:

1. **I.B. Flader, Y. Chen, Y. Yang, E.J. Ng, D.D. Shin, D.B. Heinz, L. Comenencia Ortiz, A.L. Alter, W. Park, K.E. Goodson, T.W. Kenny**, "Micro-Tethering for Fabrication of Encapsulated Inertial Sensors with High Sensitivity", JMEMS (2019).
2. **H.J. Kim, K. Kaplan, P. Schindler, S. Xu, M.M. Winterkorn, D. Heinz, T. English, J. Provine, F.B. Prinz, T. Kenny**, "Electrical Properties of Ultrathin Platinum Films by Plasma Enhanced Atomic Layer Deposition", ACS Applied Materials and Interfaces, 11, 9594 (2019).
3. **J. Rodriguez, S.A.Chandorkar, C.A. Watson, G.M, Glaze, C.H. Ahn, E.J. Ng, Y. Yang, T.W. Kenny**, "Direct Detection of Akhiezer Damping in a Silicon MEMS Resonators", Scientific Reports 9, 2244 (2019).
4. **J.M.L. Miller, A. Ansari, D.B. Heinz, Y. Chen, I.B. Flader, D.D. Shin, L.G. Villanueva and T.W. Kenny**, "Effective Quality Factor Tuning Mechanisms in Micromechanical Resonators", Applied Physics Reviews 5, 041307 (2018).
5. **J.M.L. Miller, H. Zhu, D.B. Heinz, Y. Chen, I.B. Flader, D.D. Shin, J.E-Y. Lee, T.W. Kenny**, "Thermal-Piezoresistive Tuning of the Effective Quality Factor of a MicroMechanical Resonator", Physical Review Applied, 10, 044055 (2018).
6. **J. Rodriguez, S.A.Chandorkar, G.M, Glaze, D.D. Gerrard, Y. Chen, D.B. Heinz, I.B. Flader, T.W. Kenny**, "Direct Detection of Anchor Damping in MEMS Tuning Fork Resonators", JMEMS 99, 1 (2018).
7. **M. Mellema, W. Behnke-Parks, A. Luong, M. Hopcroft, Claire Mills, S. Ho, R. Hsi, D. Laser, T. Kenny, R. Grubbs, M. Stoller**, "Absence of Ureteral/Renal Injury Following Low-Intensity Extracorporeal Acoustic Energy Lithotripsy with Stone-Targeting Microbubbles in an in-vivo Swine Model", The Journal of Urology 199,4 pe479, (2018).
8. **L. Comenencia Ortiz, D.B. Heinz, I.B. Flader, A.L. Alter, D.D. Shin, Y. Chen and T.W. Kenny**, "Assessing failure in epitaxially encapsulated micro-scale sensors using micro and nano x-ray computed tomography", MRS Communications 8, 275 (2018).
9. **M.T. Barako, T.S. English, S. Roy-Panzer, T.W. Kenny and Kenneth E Goodson**, "Dielectric barrier layers by low-temperature plasma-enhanced atomic layer deposition of silicon dioxide", Thin Solid Films 649, 24 (2018).
10. **Y. Chen, I.B. Flader, D.D. Shin, C.H. Ahn, J. Rodriguez and T.W. Kenny**, "Robust Method of Fabricating Epitaxially Encapsulated MEMS Devices with Large Gaps", JMEMS 26, 1235 (2017).
11. **W. Park, D.D. Shin, S.J. Kim, J.S. Katz, J. Park, C.H. Ahn, T. Kodama, M. Asheghi, T.W. Kenny, K.E. Goodson**, "Phonon Conduction in Silicon Nanobeams", Appl. Phys. Lett. 110, 213102 (2017).
12. **F. Purkl, A.Daus, T. English, J Provine, A. Feyh, G. Urban, T. Kenny**, "Measurement of Young's modulus and residual stress of atomic layer deposited Al<sub>2</sub>O<sub>3</sub> and Pt thin films", J. Micromech. Microeng. 27, 085008 (2017)

13. G. Agarwal, T. Kazior, T. Kenny, D. Weinstein, "Modeling and analysis for thermal management in Gallium Nitride HEMTs using microfluidic cooling", Journal of Electronic Packaging 139, 11001 (2017).
14. J. Atalaya, T.W. Kenny, M.L Roukes, M.I Dykman, "Nonlinear damping and dephasing in nanomechanical systems", Physical Review B, 94, 15440 (2016).
15. O. Shoshani, **D. Heywood, Y. Yang**, T.W. Kenny, and S.W. Shaw, "Phase Noise Reduction in an MEMS Oscillator Using a Nonlinearly Enhanced Synchronization Domain", JMEMS 25 (2016).
16. **Y. Yang, E.J. Ng**, P.M. Polunin, **Y.Chen, I.B. Flader**, S.W. Shaw, M.I. Dykman, and T.W. Kenny, "Nonlinearity of Degenerately Doped Bulk-Mode Silicon MEMS Resonators", JMEMS 25, 859 (2016).
17. **T.S. English**, J. Provine, A.F. Marshall, A.L. Koh, T.W. Kenny, "Parallel preparation of plan-view transmission electron microscopy specimens by vapor-phase etching with integrated etch stops", Ultramicroscopy 166, 39 (2016).
18. **Y. Yang, E.J. Ng, Y. Chen, I.B. Flader**, T.W. Kenny, "A Unified Epi-Seal Process for Fabrication of High-Stability Microelectromechanical Devices", JMEMS 25, 489 (2016).
19. **D.B. Heinz, V.A. Hong, C.H. Ahn, E.J. Ng, Y. Yang**, and T.W. Kenny, "Experimental Investigation into Stiction Forces and Dynamic Mechanical Anti-Stiction Solutions in Ultra-Clean Encapsulated MEMS Devices", JMEMS 25, 469 (2016)
20. P.M. Polunin, **Y. Yang**, M.I. Dykman, T.W. Kenny, and S.W. Shaw, "Characterization of MEMS Resonator Nonlinearities Using the Ringdown Response", JMEMS 25, 297 (2016).
21. **C.H. Ahn, E.J. Ng, V.A. Hong, J. Huynh, S. Wang**, and T.W. Kenny, "Characterization of Oxide-Coated Polysilicon Disk Resonator Gyroscope Within a Wafer-Scale Encapsulation Process", JMEMS 24, 1687 (2015).
22. B.W. Soon, Y. Qian, **E.J. Ng, V.A. Hong, Y. Yang, C.H. Ahn**, T.W. Kenny, and C. Lee, "Investigation of a Vacuum Encapsulated Si-to-Si Contact Microswitch Operated From -60°C to 400°C", JMEMS 24 1906, (2015).
23. **Y. Won**, Y. Gao, R. Guzman de Villoria, B.L. Wardle, R. Xiang, S. Maruyama, T.W. Kenny, and K.E. Goodson, "Nonhomogeneous morphology and the elastic modulus of aligned carbon nanotube films", Journal of Micromechanics and Microengineering 25, 115023 (2015).
24. M.T Barako, S. Roy-Panzer, T.S. English, T. Kodama, M. Asheghi, T.W. Kenny, and K.E. Goodson, "Thermal Conduction in Vertically Aligned Copper Nanowire Arrays and Composites", ACS Applied Materials and Interfaces, 34, 19251 (2015).
25. V. Zega, S.H. Nitzan, M. Li, **C.H. Ahn, E. Ng, V. Hong, Y. Yang**, T.W. Kenny, A. Corigliano, and D.A. Horsley, "Predicting the closed-loop stability and oscillation amplitude of nonlinear parametrically amplified oscillators<sub>SEF</sub>", Appl. Phys. Lett. 106, 233111 (2015).
26. S.H. Nitzan, V. Zega, M. Li, **C.H. Ahn**, A. Corigliano, T.W. Kenny and D.A. Horsley, "Self-Induced Parametric Amplification arising from Nonlinear Elastic Coupling in a Micromechanical Resonating Disk Gyroscope", Scientific Reports 5:9036 (2015)
27. **C.H. Ahn, E.J. Ng, V.A. Hong, Y. Yang, B. Lee, I. Flader** and T.W. Kenny, "Mode-Matching of Wineglass-Mode Disk Resonator Gyroscope in (100) Single Crystal Silicon", JMEMS 24, 343 (2015).

28. **V.A. Hong, S. Yoneoka, M.W. Messana, A.B. Graham, J.C. Salvia, T.T. Branchflower, E.J. Ng** and T.W. Kenny, “Fatigue Experiments on Single-Crystal Silicon in an Oxygen-Free Environment”, JMEMS 24, 351 (2015).
29. **E.J. Ng, V.A. Hong, Y. Yang, C.H. Ahn, C.L.M. Everhart** and T.W. Kenny, “Temperature Dependence of the Elastic Constants of Doped Silicon”, JMEMS 24 730, (2015)
30. C.L. Roozeboom, B.E. Hill, **V.A. Hong, C.H. Ahn, E.J. Ng, Y. Yang**, T.W. Kenny, M.A. Hopcroft and B.L. Pruitt, “Multifunctional Integrated Sensors for MultiParameter Monitoring Applications”, JMEMS 24, (2015).
31. **S. Ghaffari, E.J. Ng, C.H. Ahn, Y. Yang, S. Wang, V.A. Hong**, and T.W. Kenny, “Accurate Modeling of Quality Factor Behavior of Complex MEMS Resonators”, JMEMS 24, 276 (2015)
32. **C.H. Ahn, S. Nitzan, E.J. Ng, V.A. Hong, Y. Yang, T. Kimbrell, D.A. Horsley**, and T.W. Kenny, “Encapsulated High Frequency (235 kHz), High-Q (100k) Disk Resonator Gyroscope with Electrostatic Parametric Pump”, Applied Physics Letters, 105, 243504 (2014).
33. B.W. Soon, **E.J. Ng, V.A. Hong, Y. Yang, C.H. Ahn**, Y. Quan, T.W. Kenny and C. Lee, “Fabrication and Characterization of a Vacuum-Encapsulated Curved Beam Switch for Harsh Environment Application”, JMEMS 23, 1121 (2014).
34. Y. Won, Y. Gao, M.A. Panzer, R. Xiang, S. Maruyama, T.W. Kenny, W. Cai, and K.E. Goodson, “Zippering, entanglement, and the Elastic Modulus of Aligned Single-Walled Carbon Nanotube Films”, Proceedings of the National Academy of Sciences, 110, 20426 (2013).
35. **M.A. Philippine**, H. Zareie, O. Sigmund, G.M. Rebeiz, and T.W. Kenny, “Experimental Validation of Topology Optimization for RF MEMS Capacitive Switch Design”, JMEMS 22, 1296 (2013).
36. **S. Ghaffari, S.A. Chandorkar, S. Wang, E.J. Ng, C.H. Ahn, V. Hong, Y. Yang**, and T.W. Kenny, “Quantum Limit of Quality Factor in Silicon Micro and Nano Mechanical Resonators”, Scientific Reports, 3:3244 (2013).
37. M. Li, **E.J. Ng, V.A. Hong, C.H. Ahn, Y. Yang**, T.W. Kenny and D.A. Horsley, “Lorentz Force Magnetometer using a Micromechanical Oscillator”, Appl. Phys. Lett 103, (2013)
38. **H.K. Lee, R. Melamud, B. Kim, S. Chandorkar, J.C. Salvia** and T.W. Kenny, “The effect of Temperature-Dependent Nonlinearities on the Temperature Stability of Micromechanical Resonators”, J. Appl. Phys. 114, (2013)
39. R.G. Hennessy, M.M. Shulaker, **M. Messana, A.B. Graham**, N. Klewa, J. Provine, T.W. Kenny and R.T. Howe, “Vacuum Encapsulated Resonators for Humidity Measurement”, Sensors and Actuators B-Chemical 185, 575 (2013)
40. **S. Ghaffari, C.H. Ahn, E.J. Ng, S. Wang** and T.W. Kenny, “Crystallographic Effects in Modeling Fundamental behavior in MEMS Silicon Resonators”, Microelectronics Journal 44, 586 (2013)
41. **E. Ng, H-K Lee, C-H Ahn, R. Melamud** and T.W. Kenny, “Stability of Silicon Microelectromechanical Systems Resonant Thermometers”, IEEE Sensors 13, (2013).
42. **M.A. Philippine**, O. Sigmund, G.M Rebeiz, and T.W. Kenny, “Topology Optimization of Stressed Capacitive RF MEMS Switches” JMEMS 22, 206 (2013)

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