HOWARD E. KATZ
Professor, Department of Materials Science and Engineering
Professor of Chemistry (joint appointment), Johns Hopkins University
(410) 516-6141, hekatz@jhu.edu

Professional Preparation
Massachusetts Institute of Technology, Chemistry, Sc.B., 1978
Massachusetts Institute of Technology, Humanities and Science, Sc.B., 1978
University of California, Los Angeles, Organic Chemistry, Ph.D., 1982

Appointments
Professor of Materials Science and Engineering (Jan. 2004-present), Johns Hopkins University
Professor of Chemistry (joint appointment, Dec. 2004-present), Johns Hopkins University
Chair, Department of Materials Science and Engineering, Johns Hopkins, July 2008-June 2014
Honorary Professor, University of Wisconsin, January, 2012
Distinguished Member of Technical Staff (1998-2004), Bell Laboratories
Member of Technical Staff, (1982-1998), Bell Laboratories.

Research Interests
Organic/hybrid materials, especially organic semiconductors and photonic polymers. Novel conjugated compounds, molecular recognition, novel approaches to fabrication, high-field devices, volatile compound and biomarker sensing, energy conversion and logic devices

Honors, Awards, and Leadership

2017	Elected to National Academy of Inventors
2015	Elected Member, Johns Hopkins Academic Council
2014	NIH NIBIB Biomaterials Study Section
2014	Organizer, NSF/DOE/NIST workshop on computational organic semiconductors
2014	Meeting chair, DOE Basic Energy Sciences Materials Chemistry program retreat
2013	Member, biosensor advisory board for Flextech
2010	Second-year Fellow of the American Chemical Society
2009	President, International Union of Materials Research Societies
2008	Inaugural Fellow of the Materials Research Society
2007	Fellow of the American Physical Society
2006	JHU Teaching Award finalist
2004	AAAS Fellow Award
2002	R&D100 Award (two inventions, plastic electronics and holographic recording)
2001	Materials Research Society Board of Directors; President 2004

Grants

Approximately $7 million raised in twelve years for organic, polymer and hybrid sensors, transistors, interfacial chemistry, and energy conversion materials

Grants and Contracts: Selected active grants and contracts:

NIH: *Transistor and Circuit Designs for Real Time Brain Injury Biomarker Detection*

NSF: *Study of conjugated polymers and dopants co-assembling for highest mobile charge density and charge carrier mobility through synthesis, electronic testing, and x-ray diffraction studies*

NSF DMREF: *Self-assembled peptide-pi-electron supramolecular polymers for bioinspired energy harvesting, transport and management.*

Department of Energy: *Molecularly Designed Localized Static Charging for Energy Efficiency in Organic Electronics*

Selected completed grants and contracts

Department of Energy: S*elf-assembly of PI-Conjugated Peptides in Aqueous Environments Leading to Energy-Transporting Bioelectronic Nanostructures*

National Institute for Occupational Safety and Health: D*evelopment of New Generation Gas and Vapor Sensors Using Organic Electronics*

National Science Foundation: N*anoscale Electric Fields in Self-Assembled Optoelectronic Biomaterials*

National Science Foundation: *University of Wisconsin MRSEC on Structured Interfaces*

National Science Foundation: *Gate-Modulated Charge Density-Dependent Physics of Low-Dimensional Inorganic Semiconductors in Organic Multilayers*

National Science Foundation: *Solution-Processed Oxide Dielectrics and Integrated Electronic Materials for Low-Voltage Transparent Transistors*
National Science Foundation: *IMPACT (Imprinted Polymer Array for Counterterrorism)*

National Science Foundation: *P-N Interfacing Probing and Design for Organic/Hybrid Photovoltaics and Circuits*

National Science Foundation: *Pyromellitic Diimide (PyDI)-Based Molecular and Polymeric Electron-Transport*

National Science Foundation: *Materials Research Science & Engineering Center on Spintronics*

Air Force Office of Scientific Research: *Electron-Transporting Semiconductors*

Courses taught

Introduction to Materials Chemistry, Electronic Materials Laboratory, Chemistry of Materials Synthesis, Polymer Chemistry and Physics, Biosensors, Micro-Nano Materials and Devices, Electronic Properties of Materials (Spring 2018)

Graduate Students and Postdoctoral Fellows Mentored

O. Alley, J. Bai (Tufts), K. Besar, Y. Chu, C. Huang (PNNL), J. Dailey, T. Dawidcyk, K. Deshmukh (Thermax), B.M. Dhar, (NIST/MIT/Agira), A. Facchetti (Polyera/Northwestern), H. Fan, P. Gopalan (Wisconsin), J. Granstrom (UCSB), X. Guo, X.M. Hong, C. Huang (PNNL), J. Huang (Shanghai), W. Huang (UMass), R. Ireland, H. Jang, B. Jung (Seoul), T. Kale, H. Kong (KRICT Korea), S. Kirschner, S. Kola, C. Landis (Plextronics), J.G. Laquindanum (Teledyne), T. Lee, T.G. Lee (Samsung), H. Li, Y. Liu, D. Madan, A.S. Malik (Diamond Innovations), A. Maliakal (Lucent), J.F. Martinez Hardigree (Oxford), M. Mushrush (Dow), Y. Ollsen (MIT), B. Pal (Los Alamos), E. Plunkett, K.See (Lux), W. Shi, J. Sinha, J. Song, J. Sun (Agilent), N. Tremblay (Nanoterra), B. Pal (IIT Bankura), S. Ungashe (Affymax), S. Vaidyanathan (BASF), Q. Xu (UCLA), M. Yeh, B. Zhang (Towson), X. Zhao (Northwestern), Q. Zhang, Q. Zheng (Fujian).

Advisory Boards and Professional Service

Editorial Advisory Boards: Chemistry of Materials, ACS Applied Materials and Interfaces, Journal of Materials Research (Associate Editor), MRS Communications

Company Advisory Boards: Orthogonal Inc., Agira, Nanobio Materials Consortium

Materials Research Society: Symposium Organizer, Meeting Chair, Government Affairs Committee Chair, Executive Branch Blue Ribbon Nomination Committee Chair

Symposia organized and funded

- "Multidentate Anion Complexation", ACS Spring Meeting, Denver, 1987
- "Ordered Materials by Design", MRS Fall Meeting, Boston, 1992
- "Nanostructures in Electronic and Bio Materials", Baekeland Award Symposium, 1995 (North Jersey American Chemical Society Executive Committee activity)
- "Synthesis of Nanoscale and Nanostructured Materials", DARPA, 1998-1999
- "Physics of Nanoscale and Nanostructured Materials", DARPA, 1999-2000
- "Large Area and Woven Electronics", DARPA, 2000-2001
- "Active Organic Materials", ACS Spring Meeting, San Diego, 2001
- "Materials for Transport and Manipulation of Light", DARPA 2002
- "Materials with Enhanced Performance and Malleability", DARPA 2002-2003
- "Hardware for Intelligent Systems", DARPA 2003-2004
- "Active Organic and Hybrid Materials", ACS Pacific Basin Meeting, 2005
- Energy Forum, IUMRS-ICAM Meeting, Brazil, 2009
- "Polymer and Composite Thermoelectric Materials", MRS Fall Meeting, 2016

CHEMICAL & ENGINEERING NEWS, TECHNOLOGY REVIEW, AND SCIENCE RECOGNITION

- Rate enhancements in serine protease models, 1983
- "Hydride Sponge" and anion complexation, 1984
- Poly(vinyl chloride) stabilization chemistry, 1984
- Interlayer electron transfer in zirconium phosphonate self-assemblies, 1992
- Thin film transistors with exceptional on/off ratios, 1995
- Heterostructure organic thin film transistors, 1995
- Liquid phase-deposited thin film transistors, 1998 (twice)
- Holographic storage media, 1999
- Soluble and air-stable n-channel organic FET semiconductors, 2000
- Organic semiconductors recognized in Science top ten discovery list, 2000
- Additional press coverage: Technology Review and IEEE Spectrum, 2002
- "Demo" photoessay on plastic transistors, 2003
- Electron-transporting phenylene-thiophene oligomers, 2003
- Layered alumina high-capacitance dielectrics, Nature Materials perspective, 2009

Publications and patents

Approximately 280 publications with h-index approximately 75. Twenty-four papers with over 200 citations. About 18,000 total citations. Fifty-two US patents granted.

Selected significant patents (51 US patents in all)

Katz, H.E.; Kong, H. "Electro-chemical Sensors, Sensor Arrays, and Circuits"
U.S. Patent 8,772,764 2014

Katz, H.E.; Pal, B. "Devices Having High Dielectric Constant, Ionically-polarizable Materials"
U.S. Patent 8,766,246 2014

Katz, H.E.; Zheng, Q. "Pyromellitic diimide organic semiconductors and devices"
U.S. Patent #8,269,215 2012

Katz, H.E. "Methods for producing multiple distinct transistors from a single semiconductor"
U.S. Patent #7,993,959 2011

Dhar, L.; Hale, A.; Katz, H.E.; Shilling, M.L.; Schnoes, M. "Optical article and process for forming article"
U.S. Patent #6,939,648 2005

Dodabalapur, A.; Katz, H.E.; Sarpeshkar, R. "Organic polarizable gate transistor apparatus and method" U.S. Patent #6,870,180 2005

Erben, C.; Gill, D.; Katz, H.E.; Lee, M. "Electro-optical modulators"
U.S. Patent #6,819,808 2005 and U.S. Patent #6,711,308 2004

Dodabalapur, A.; Gelperin, A.; Katz, H.E. "Odor sensor with organic transistor circuitry"
U.S. Patent #6,661,299 2003

Katz, H.E. "Process for fabricating organic semiconductor device involving selective patterning"
U.S. Patent #6,403,397 2002

Katz, H.E.; Li, W.; Lovinger, A.J. "Device comprising n-channel semiconducting material"
U.S. Patent #6,387,727 2002

Dhar, L.; Katz, H.E. "Material exhibiting compensation for polymerization-induced shrinkage and recording medium formed therefrom" U.S. Patent #6,221,536 2001

Chidsey, C.E.D.; Katz, H.E.; Putvinski, T.M.; Scheller, G.; Schilling, M.L.; Wilson, W.L.
"Stable polar optically nonlinear multilayer films and devices using the same"
U.S. Patent #5,326,626 1994 and U.S. Patent #5,217,792 1993

Dirk, C.W.; Katz, H.E.; Lalama, S.J.; Singer, K.D.; Sohn, J.E. "Nonlinear optical materials and devices"
U.S. Patent #4,859,876 1989

Selected Significant and Highly Cited Publications (h-index about 75)

Dodabalapur, A.; Torsi, L.; Katz, H.E. "Organic transistors: two-dimensional transport and improved electrical characteristics" Science, 268, 270-1 (1995), 820 citations

Katz, H.E.; Bao, Z.; Gilat, S.L. "Synthetic chemistry for ultrapure, processable, and high mobility organic semiconductors", Acc. Chem. Res. 34, 359-369 (2001), *review,* 764 citations

Katz, H.E.; Lovinger, A.J.; Johnson, J.; Kloc, C.; Siegrist, T.; Li, W.; Lin, Y.-Y.; Dodabalapur, A. “A soluble and air-stable organic semiconductor with high electron mobility” Nature 404, 478-481 (2000), 759 citations

Katz, H.E.; Scheller, G.; Putvinski, T.M.; Schilling, M.L.; Wilson, W.L.; Chidsey, C.E.D. "Polar orientation of dyes in robust multilayers by zirconium phosphate-phosphonate interlayers" Science, 254, 1485-1487 (1991), 313 citations

Katz, H. E.; Singer, K. D.; Sohn, J. E.; Dirk, C. W.; King, L. A.; Gordon, H. M."Greatly enhanced second-order nonlinear optical susceptibilities in donor-acceptor organic molecules" J. Am. Chem. Soc., 109(21), 6561-3 (1987), 249 citations

Crone, B.: Dodabalapur, A.; Gelperin, A.; Torsi, L.; Katz, H.E.; Lovinger, A.J.; Sarpeshkar, R.; Bao, Z. “Electronic sensing of vapors with organic field-effect transistors” Appl. Phys. Lett. 78, 2229-2231 (2001), 377 citations

Mushrush, M.; Facchetti, A.; Lefenfeld, M.; Katz, H.E.; Marks, T.J. “Easily processable organic field-effect transistors and nonvolatile devices” J. Am. Chem. Soc., 125, 9414-9423 (2003), 323 citations

Laquindanum, J.G.; Katz, H.E.; Lovinger, A.J. “Synthesis, morphology, and field-effect mobility of anthradithiophenes” J. Am. Chem. Soc. 120, 664-672 (1998), 293 citations

Katz, H.E.; Johnson, J.; Lovinger, A.J.; Li, W. “Naphthalenetetracarboxylic diimide-based n-channel transistor semiconductors: structural variation and thiol-enhanced gold contacts” J. Am. Chem Soc. 122, 7787-7792 (2000), 307 citations

Katz, H.E.; Wilson, W.L.; Scheller, G. "Chromophore variation, orientational order, and second harmonic generation in zirconium phosphate/phosphonate multilayers" J. Am. Chem. Soc., 116, 6636(1994), 156 citations

Katz, H.E. "Hydride sponge: 1,8-naphthalenediylbis(dimethylborane)" J. Am. Chem. Soc., 107(5), 1420-1 (1985), 173 citations

Most Recent Selected Publications

Li, H.; DeCoster, M.E.; Ireland, R.M.; Song, J.; Hopkins, P.E.; Katz, H.E. “Modification of the Poly(bisdodecylquaterthiophene) (PQT12) Structure for High and Predominantly Nonionic Conductivity with Matched Dopants” J. Am Chem. Soc. **DOI:** 10.1021/jacs.7b05300 139 11149-11157 (2017)

Zhao, X.; Madan, D.; Cheng, Y.; Zhou, J.; Li, H.; Thon, S.M.; Bragg, A.E.; DeCoster, M.E.; Hopkins, P.E.; Katz, H.E.

"High Conductivity and Electron Transfer Validation in an n□Type Fluoride Anion Doped Polymer for Thermoelectrics in Air" Advanced Materials https://doi.org/10.1002/adma.201606928 1606928 (2017)

Besar, K.; Dailey, J.; Katz, H.E. "Ethylene Detection Based on Organic Field Effect Transistors With Porogen and Palladium Particle Receptor Enhancements" ACS Applied Materials and Interfaces DOI: 10.1021/acsami.6b12887
(2017)

Ireland, R.M.; Jones, T.; Li, H.; Jang, H.-J.; West. J.E.; Katz, H.E. "Statically Charged Electret Polymers as Solid, Nonvolatile Gates Encapsulating and Tuning Polymer Thermoelectric Parameters"
ACS Energy Letters 10.1021/acsenergylett.6b00269 (2016)

Alley, O.J.; Plunkett, E.; Kale, T.S.; Guo, X.; McClintock, G.; Bhupathiraju, M.; Kirby, B.J.; Reich, D.H,; Katz, H.E. "Synthesis, Fabrication, and Heterostructure of Charged, Substituted Polystyrene Multilayer Dielectrics and Their Effects in Pentacene Transistors" Macromol. 10.1021/acs.macromol.6b00253 49, 3478-3489 (2016)

Katz, H.E.; Poehler, T.O. "Innovative Thermoelectric Materials" (edited book and two coauthored chapters)
World Scientific, Imperial College Press, London (2016)

Alley, O.J.; Yu, M.-Y.; Johns, G.L.; Dawidczyk, T.J.; Martinez Hardigree, J.F.; Markovic, N.; Arnold, M.S.; Katz, H.E. "Negative Polarity of PCBM Adjacent to Donor Macromolecule Domains"
Appl. Phys. Lett. **106**, 033301 http://dx.doi.org/10.1063/1.490565 (2015)

Martinez Hardigree, J.F, Katz, H.E. "Through Thick and Thin: Tuning the Threshold Voltage in Organic Field-Effect Transistors" Accounts of Chemical Research, 47, 1369-1377 (2014)

Dawidczyk, T.J.; Martinez Hardigree, J.F.; Johns, T.L.; Ozgun, R.; Alley, O.; Andreou, A.G.; Markovic, N.; Katz, H.E. "Visualizing and Quantifying Charge Distributions Correlated to Threshold Voltage Shifts in Lateral Organic Transistors" ACS Nano, 8, 2714-2724
http://dx.doi.org/10.1021/nn4064067 (2014)

Weiguo Huang, Kalpana Besar, Rachel LeCover, Pratima Dulloor, Jasmine Sinha, Josué F. Martínez Hardigree, Christian Pick, Julia Swavola, Allen D. Everett, Joelle Frechette, Michael Bevan and Howard E. Katz
"Label-free Brain Injury Biomarker Detection Based on Highly Sensitive Large Area Organic Thin Film Transistor with Hybrid Coupling Layer" Chemical Science 5, 416-426 (2014)

Huang, W.; Besar, K.; LeCover, R.; Rule, A.M.; Breysse, P.N.; Katz, H.E. "Highly Sensitive NH3 Detection Based on Organic Field-Effect Transistors with Tris(pentafluorophenyl)borane as Receptor" J. Am. Chem.Soc. 134, 14650-14653 (2012)

Jung, B.J.; Martinez Hardigree J.F.; Dhar, B.M.; Dawidczyk, T.J.; Sun, J.; See, K.C.; Katz, H.E. "Naphthalenetetracarboxylic Diimide Layer-based Transistors with Nanometer Oxide and Side Chain Dielectrics Operating below One Volt", ACS Nano, 5, 2723-2734 (2011)

Dhar, B.M.; Ozgun ,R.; Dawidczyk, T.; Andreou, A.; Katz, H.E. "Threshold Voltage Shifting for Memory and Tuning in Printed Transistor Circuits" (invited) MSE Reports, doi:10.1016/j.mser.2010.11.001 (2011)

Jung, B.-J.; Tremblay, N.J.; Yeh, M.-L.; Katz, H.E. "Molecular Design and Synthetic Approaches to Electron-transporting Organic Transistor Semiconductors" (invited) Chemistry of Materials, 23, 568-582 (2011)

Sun, J.; Zhang, B.; Katz, H.E. "Materials for Printable, Transparent, and Low-voltage Transistors" (invited review) Advanced Functional Materials, 21, 29-45 (2011)

Dhar, B.M.; Kini, G.; Xia, G.; Jung, B.J.; Markovic, N.; Katz, H.E. "Field-effect Tuned Lateral Organic Diodes" Proc. Nat. Acad. Sci., 107, 3972-3976 (2010)

Someya, T.; Dodabalapur, A.; Huang, J.; See, K.C.; Katz, H.E. "Chemical and Physical Sensing by Organic Semiconductor Devices" (invited) Advanced Materials, 22, 3799-3811 (2010)

Pal, B.N.; Dhar, B.M.; See, K.C.; Katz, H.E. "Solution-Processed High Capacitance Transparent Sodium beta-Alumina Film: Application to Low Voltage Field Effect Transistors" Nature Materials, 8, 898-203 (2009)

Invited Talks--Universities and Outside Laboratories (96 altogether), most recent talks listed in inverse chronological order

University of Utah
University of Kentucky
NYU
Technion
Rutgers University
Dow Chemical Company
University of Florida
University of Massachusetts
ETH-Zurich, Switzerland
University of Melbourne
Howard University
Northrup Grumman
US Army Laboratory, Edgewood, MD
Rochester Institute of Technology
SRI Corporation
Weizmann Institute of Science
ETRI (Korea)
Samsung Corporation
Korea University
University of Maryland (3)

University of Delaware (2)
Naval Research Laboratory
National Institutes of Standards and Technology
Tokyo University, Hongo campus
Tokyo University, Kashiwa campus (Solid State Physics)
University of Michigan
Johns Hopkins University
Lehigh University
Columbia University
DuPont Central Research
University of Texas
University of Pennsylvania
Cornell University
Nihon University, Tokyo
IBM Research Laboratories, Yorktown Heights (2)
Case Western Reserve University—Frontiers Lecture
Argonne National Laboratory
Harvard University
Florida State University
Michigan State University—Alumni Lecture
University of Chicago
University of Illinois—Lane Lecture
Princeton University, Department of Electrical Engineering (2)
Cambridge University, Departments of Physics and of Chemstry
CNRS Paris
Philips Electronics-Eindhoven, Netherlands and Technical University-Eindhoven, Netherlands
California Institute of Technology
Penn State University (2)
McElvain Lecture-University of Wisconsin

Invited Talks at Meetings (77 altogether, most recent listed in reverse chronological order)

MRS National Meetings (18); ACS National Meetings (21); other Society talks (30 altogether)
International Conference on Thermoelectrics, Valencia, Winter 2018
MRS Fall Meeting Thermoelectrics (Fall 2014)
Flextech Conference (Winter 2014)
ISDRS Large Area Electronics (Fall 2013)
Grand Challenges in Organic Electronics, NSF/DOE organizer/webinar (Fall 2013)
MRS Fall Meeting Energy Interfaces (Fall 2013)
SPIE Sensors (Summer 2013)
ACS Polymer Division (Spring 2013)
American Association of Crystal Growth (Spring 2012)
EMRS Symposium on Organic and Hybrid Electronics (Spring, 2012)
IUPAC Symposium on Polymer Chemistry (Summer 2010)
ACS Award Symposium in Honor of Andrew Lovinger (Spring 2010)
SPIE Symposium on Organic Chemical and Biochemical Sensors (Fall, 2009)
IUMRS/ICA Singapore (two, Summer 2009)
Flexible Electronics and Displays Conference, Phoenix (Winter 2008)
Processes at Functional Electronic and Plasmonic Interfaces, ACS COLL (Summer, 2007)
DOD Nanosensors Symposium, Arlington, VA (Summer, 2007)

Organic Photovoltaics Intertech Workshop, Baltimore (Spring 2007)
Electroactive organics and polymers, ACS PMSE (Spring 2007)
Plastic Electronics Conference, Frankfurt, Germany (Fall 2006)
Nanotechnology Broadcast, Northwestern University (Fall 2006)
Electronic Materials Conference, Penn State (Summer 2006)
European MRS Symposium on Transistor Sensors (Spring 2006)
NIST Organic Electronics workshop, Gaithersburg, MD (Spring 2006)
Device Research Symposium, Bethesda, Maryland (Fall 2005)
Materials Research Society Symposium on Electroresponsive Polymers (Fall, 2005)
SUNY "Conversations in Nanotechnology" Conference (Fall, 2004)
Gordon Conference on Electron Donor-Acceptor Interactions (Summer 2004)
International Symposium on Hybrid Matrials, Tokyo (Fall 2003)
American Chemical Society Symposium on Organic Electronics (Fall 2003)
Kwiram Symposium on Organic Materials, University of Washington (Summer 2003)
MRSEC Review conference, University of Minnesota (Spring 2003)
Materials Research Society Symposium on Active Organics (Spring 2003)
ACS Chemistry of Materials Award Symposium (Spring 2003)
Rochester ACS Symposium on Materials for the Information Age (Fall, 2002)
Plenary Lecture, Gordon Conference on Organic Structures, Japan (Summer 2002)
Materials Research Society Symposium on Organic Electronics (Spring 2002)
American Chemical Society Symposium on Organic and Molecular Electronics (Spring 2002)
American Physical Society focused session, Displays, Memories, and Sensors (Spring 2002)
Symposium on Nanostructured Materials, University of Wisconsin (Fall 2001)
Symposium on Nanostructures and Life Sciences, University of Pennsylvania (Fall 2001)
Joint Taiwan-US "Chemtech" Chemical Engineering Symposium (Fall 2001)
SPIE Symposium on Organic Field-effect Transistors (Summer 2001)
National Research Council/NAS Workshop on Materials Chemistry (Spring 2001)
Materials Research Society Symposium on Patterning Soft Materials (Spring 2001)
Materials Research Society Symposium on Electronic/Optical Polymers (Spring 2001)
ACS Chemistry of Materials Award Symposium (Spring 2001)
Institute for Molecular Science, Okazaki, Japan (Spring 2001)
American Physical Society Symposium on Molecular Electronics (Spring 2000)