# Farhang Shadman

**Address:**

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**Personal Data:**

U.S. Citizen
Born on November 12, 1945
Married; two children

**Education:**

Ph.D. in Chemical Engineering
University of California, Berkeley, California (1972)

M.S. in Chemical Engineering
University of California, Berkeley, California (1969)

B.S. in Chemical and Refinery Engineering (1963; ranked first in graduating class)
Abadan Institute of Technology, Iran

**Current Research Interest:**

- Novel Materials and Processes for Environmentally Benign Micro- and Nano-Electronics Manufacturing
- Fabrication and Characterization of Ultra-Thin Film Dielectrics
- Processes, Materials, and Metrology for Ultra-Purification of Fluids

**Employment:**

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| 1989 - Present | Regents Professor<br>Department of Chemical and Environmental Engineering,<br>Optical Sciences Center (joint appointment since 1999),<br>University of Arizona, Tucson, Arizona |
| 1995 - Present | Director, Engineering Research Center on Environmentally Benign Semiconductor Manufacturing,<br>Partners: University of Arizona, Massachusetts Institute of Technology, Stanford University, University of California at Berkeley, Cornell University, Purdue University, Columbia University, University of Massachusetts, Tufts University |
| 1991 - 1995 | Co-Director, Sematech Center of Excellence on Contamination/Defect Control,<br>University of Arizona, Tucson, Arizona. |

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| 1983 - 1989 | Associate Professor, Department of Chemical Engineering, University of Arizona, Tucson, Arizona. |
| 1979 - 1983 | Assistant Professor, Department of Chemical Engineering, University of Arizona, Tucson, Arizona. |
| 1976 - 1979 | Senior Research Engineer, General Motors Research Laboratories, Warren, Michigan. |
| 1972 - 1976 | Director, Air Pollution Research Center Sharif University of Technology, Tehran, Iran. |

**Honors and Awards:**

- *Innovation Award*, sponsored by Semiconductor International, SEMICO (July 2009)
- *Regents Professor*, appointment by the Arizona Board of Regents (June 2005)
- *Akira Inoue Award*, Semiconductor Equipment and Materials International (Dec 2002)
- *Fellow*, American Institute of Chemical Engineering (2002)
- *Landmark Innovation Award*, Semiconductor Research Corporation (October 2000)
- *Excellence in Research Award*, SRC/Sematech/SIA (April 1998)
- *Best Paper Award* (with Asad Iqbal, Harpreet Juneja, Junpin Yao) SRC Symposium, October, 2006, Raleigh, North Carolina.
- *Best Paper Award* (with Mohith Verghese), Techcon (September 1998)
- *Best Paper Awards* (with Eric Shero), Techcon (September1997)
- *Invention Award*, SRC/SEMATECH (April 1994)
- *Excellence in Research Award*, SRC/SEMATECH (June 1992)
- *Invention Award*, SRC/SEMATECH (March 1992)
- *Best Paper Award*, Motorola SABA Annual Conference (October 1992)
- *Best Paper Award*, Soc. of Electron Microscopy and Microbeam Analysis (March 1990)
- *Best Paper Award*, IEEE/CHMT International Meeting (September 1990)
- *Cahn Innovation Award*, Cahn Instruments Company, for "significant contributions in the field of high-temperature adsorbents technology," 1989
- *Professor-of-the-Year Award*, College of Engineering and Mines, U of Arizona, 1983
- *Excellence in Research Award*, Ministry of Higher Education, Iran, 1975
- Honorary Gold Medal for ranking first in the annual nationwide entrance examinations to all Iranian universities, 1963

**Book and Book Chapters**:

- Shadman, F. “Recovery and Recycling of Industrial Wastewater by Hybrid Processes,” Chapter in “*Economic Sustainability Through Clean Manufacturing Methods*”. Editors: J Coca-Prados and G. Gutierrez, Published by Springer (2012).
- Philipossian, A., Boning, D., Shadman, F., Kinoshita, M. and Doi, T. “Planarization Technical Term Dictionary,” ISBN4-907847-09-2. Published by Global Net Corporation, Tokyo, Japan (2004).
- Shadman, F., “Novel Membrane Materials and Low-Energy Processes for Ultra-purification of Water,” and "Advances in Surface Preparation and Cleaning," chapters

in *Microelectronics Manufacturing and Environment;* compilation, currently on CD-ROM; under revision for publication.

- Zhao, Y. and Shadman, F., "Production of Oxygen from Lunar Ilmenite," chapter in *Resources of Near-Earth Space*, edited by John Lewis; published by University of Arizona Press, Tucson, Arizona, 1993.
- Uberoi M. and Shadman, F. "Metal Emissions Control Using Sorbents," chapter in *Clean Energy from Wastes*, edited by M. Rashid Khan; published by American Chemical Society, Washington, DC 1992.

**Journal Publications:**

- Zamani, D., Dhane, K., Mahdavi, O., McBride, M., Yan, J., and Shadman, F. "Surface Cleaning of Small Structures during Spin Rinsing of Patterned Substrates" accepted for publication in *Microelectronics Engineering Journal (2012).*
- Hao Wang, H. and Shadman, F. "Effect of Particle Size on the Adsorption and Desorption Properties of Oxide Nanoparticles" accepted for publication, *AIChE Journal (2012).*
- Rottman, J., Platt, L., Sierra-Alvarez R, Shadman F. 2013. Removal of $TiO_2$ nanoparticles by porous media: effect of filtration media and water chemistry. *Chem. Eng. Journal*, 217(1), 212-220 (2013).
- Rottman, J., Sierra-Alvarez, R., Shadman, F. "Real-time Monitoring of Nanoparticle Retention in Porous Media" *Environ. Chem. Letters*, DOI 10.1007/s10311-012-0381-3 (2012)
- Rottman, J., Sierra-Alvarez, R., and Shadman, F, "Interactions of Inorganic Oxides Nanoparticles with Sewage Biosolids" *Water Science and Technology* 66 (9), 1821-1827 (2012).
- Shadman, F. "Environmental Challenges and Opportunities in Nanoelectronics Manufacturing", *Current Opinions in Chemical Engineering, 1(3), 258-268 (2012).*
- Zamani D., Keswani M., Mahdavi O., Yan J., Raghavan S., Shadman, F. "Dynamics of Interactions between HF and Hafnium Oxide during Surface Preparation of High-K Dielectrics", *IEEE Transactions on Semiconductor Manufacturing, 25(3), 2012.*
- Field, J.A., Luna-Velasco, A., Boitano, S. A., Shadman, F., Ratner, B.D., Barnes, C., and Sierra-Alvarez, R., "Cytotoxicity and Physicochemical Properties of Hafnium Oxide Nanoparticles," *Chemosphere 84, 1401(2011).*
- H. Wang J. Yao, and F. Shadman, "Characterization of the Surface Properties of Nanoparticles Used in Semiconductor Manufacturing," *Chemical Engineering Science 66, 2545 (2011).*
- Dhane, K., Han, J., Yan, J., Mahdavi, O., Zamani, D., Vermeir B., and Shadman F., "Dynamics of Cleaning and Rinsing of Micro and Nano Structures in Single-Wafer Cleaning Tools," *IEEE Transactions on Semiconductor Manufacturing, 24(1), 125 (2011).*
- Yao J., Wang, H., Dittler, R., Geisert, C., and Shadman, F., "Application of Pressure-Cycle Purge in Dry-down of Ultra-High-Purity Gas Distribution Systems," *Chemical Engineering Science.* 65, 5041 (2010).

- Zhang X., Yan J., Vermeire B., Shadman F., and Chae J., "Passive wireless monitoring of wafer cleanliness during rinsing of semiconductor wafers," *IEEE Sensors Journal, 10 (6), 1048 (2010).*
- Juneja H., Yao H. J., Iqbal, A., and Shadman, F. "Effect of Sampling Line Characteristics on the Dynamic Monitoring of Fluid Concentration", *I&EC Research, 48(11), 2009.*
- Yan J. , Dhane, K., Vermeire, B., and Shadman, F. "In-Situ and Real-Time Metrology during Rinsing of Micro- and Nano-Structures," *Microelectronics Engineering, 86 (2), 199-205 (2009).*
- Yao, J., Iqbal, A., Juneja, H., and Shadman, F., "Moisture Uptake and Outgassing in Patterned and Capped Porous Low-k Dielectric Films," *Journal of the Electrochemical Society*, 154(10) G199-206 (2007).
- Juneja, H., Iqbal, A., Yao, J., and Shadman, F. "Mechanism and Kinetics of Non-Equilibrium and Multi-Layer Adsorption and Desorption of Gases on Solids," *I&EC Fundamenta*ls, 45(20), 2006.
- Iqbal, A., Juneja, H., Yao, J., and Shadman, F. "Removal of Moisture Contamination from Porous Polymeric Low-k Dielectric Films," *AIChE Journal* 52 (4), 1586 (2006).
- Philipossian, A., Shadman, F., Levy, P., Tousi, S., Gotlinsky, B., Rader, S., Lefevre, P., Koshiyama, I. " Characterizing Recycled Fumed Silica Slurries in ILD CMP Applications," *Micro*, 23(7), 71 (2005).
- Sorooshian, J., DeNardis, D., Charns, L., Li, Z., Shadman, F., Boning D., Hetherington D., and Philipossian A., "Arrhenius Characterization of ILD and Copper CMP Processes" *Journal of Electrochemical Society*, 151(2) G85-G88 (2004).
- Yao, M.A., Wilson, A.R., McManus, T.J., and Shadman, F. "Comparative Analysis of the Manufacturing and Consumer Use Phases of Two Generations of Semiconductor Microprocessors," *Environmental Science and Technology*, August 2004.
- Shadman, F., and McManus, T. " Comments: Energy and Material Use in the Production of Semiconductor Devices", *Environmental Science and Technology*, 38(6), 1915 (2004).
- Yan, J., Seif, D., Raghavan, S., Vermeire, B., Barnaby, H., Peterson, T., and Shadman, F. "Sensor for Monitoring the Rinsing of Patterned Wafers," *IEEE Transactions on Semiconductor Manufacturing*, 17(4), 531 (2004).
- Raghu, P., Yim, C., Iqbal, A., Shero, E., Verghese, M., and Shadman, F., "Mechanistic Study of Surface Contamination of Dielectric Oxides Using Isotope Labeling", *I&EC Research* 43, 2977 (2004).
- Prashant R., Yim C., Shero, E., and Shadman, F. "Susceptibility of Silicon, Zirconium, and Hafnium Dielectric Oxides to Moisture Contamination," *AIChE Journal* 50(8), 1881 (2004).
- Morris, R.E., Krikanova, E., and Shadman, F. "Photocatalytic Membrane for Removal of Organic Contaminants During Ultra-Purification of Water," *Clean Technologies and Environmental Policy*, 6(2), 96 (2004).
- Raghu, P., Rana, N., Yim, C., Shero, E., and Shadman, F., "Adsorption of Moisture and Organic Contaminants on Hafnium Oxide, Zirconium Oxide, and Silicon Oxide Gate Dielectrics," *Journal of the Electrochemical Society*, 150 (10), (2003).
- Rana, N., Raghu, P., Shero, E., and Shadman, F. "Interactions of Moisture and Organic Contaminants with $SiO_2$ and $ZrO_2$ Gate Dielectric Films," *Applied Surface Science*, 205(1-4), 160 (2003).

- Rana, N. and Shadman, F., "Effect of Interfacial and Bulk Contamination on the Quality of Ultra-Thin Silicon Oxide," *IEEE Transactions on Semiconductor Manufacturing*, 16(1), (2003).
- Rana, N. Raghu, P. and Shadman, F., "Kinetics and Mechanism of Carbon Incorporation in Ultra-Thin Silicon-Based Dielectric Films", *J. Electrochemical Society*, 149 (5), F35 (2002).
- Schmotzer, M., Castro, M. E., and Shadman, F. "Activated Carbon Removal of Organic Contaminants in Ultra-Pure Water Systems with Recycle" *J. Clean Technologies and Environmental Policy*, 4 (2), 125 (2002).
- Shadman, F. Interview and Feature Article on ERC, *Micro Magazine* 16-19 (April 2002).
- Kin, K. T. and Shadman, F., **"**Mechanisms for Synergistic Oxidation of Organics in Ultrapure Water Systems," *IEEE Transactions on Semiconductor Manufacturing*, 13 (1), 1 (2000).
- Shadman, F., "Clean Production in Semiconductor Industry: an Integrated Approach," *J. Clean Products and Processes*, 2 (1), 2 (2000).
- Wu, B., Peterson, T.W., Shadman, F., Senior, C.L., Morency, J.R., Huggins, F.E., and Huffman, G.P., " Interactions Between Vapor-Phase Mercury Compounds and Coal Char in Synthetic Flue Gas," *Fuel Processing Technology*, 63, 93 (2000).
- Scherer, D., Gadow, R., and Shadman, F., "$TiO_2$ Ceramic Membranes with Catalytic Reactivity for Ultra-Purification of Water," *Ceramics Transactions*, 101, 285 (2000).
- Shadman, F., Feature article on ERC and Design for Environment in Microelectronics Manufacturing, editor's interview, *Micro Journal*, 18 (4), 19 (2000).
- Verghese, M., Shero, E. and Shadman, F. "Multicomponent interactions of moisture and organic impurities with the wafer surface," *Electrochemical Processing in ULSI Fabrication*, PV 274, p. 274, The Electrochemical Society Proceedings Series, Pennington, NJ (1999)
- Kin, K.T., DeGenova, J., and Shadman, F., "Oxidation of Organic Impurities in the Recycle and Reclaim Loops of Ultra-Pure Water Plants," *J. Clean Products and Processes*, 1, 31 (1998).
- Gotlinsky, B., O'Sullivan, J., Shadman, F., Horikoshi, M., and Babasaki S., "PPT Purification for Elimination of Process Variables," *Solid State Technology*, 41(4), 67 (1998).
- DeGenova, J. and Shadman, F., "Recovery, Reuse, and Recycle of Water in Semiconductor Wafer," *Environmental Progress*, 16 (4), 263 (1997).
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- Ma, C. Shero, E. Verma, N. Gilbert, S., and Shadman, F., "Permeation of Moisture and Oxygen Through Polymeric O-Rings," *J. Inst. of Environmental Sciences*, 38(2),

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- Governal, R.A., Bonner, A.L., and Shadman, F., "Effect of System Interactions on the Removal of Total Oxidizable Carbon from DI Water Polishing Loops," *IEEE Transactions on Semiconductor Manufacturing*, 5 (1), 70 (1992).
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- Governal, R.A. and Shadman, F., "Combining ozone and UV-185 to Oxidize and Remove Organic Particles form Ultrapure Water Environment," *Microcontamination J.*, 10 (2), 25 (1992).
- Governal, R.A., Bonner, A.L., and Shadman, F., "Effect of System Interactions on the Removal of TOC from DI Water Polishing Loops," *IEEE Journal, Components, Hybrids and Manufacturing Technology*, 5 (1), 141 (1992).
- Governal, R. A., Yahya, M., Gerba, C., and Shadman, F., "Comparison of Assimilable Organic Carbon (AOC) and Total Oxidizable Carbon (TOC) in Ultra-Pure Water Systems," *Journal of Applied and Environmental Microbiology*, 58 (2), 724 (1992).
- Haider, A. and Shadman, F., "Desorption of Moisture from Stainless Steel Tubes and Alumina Filters in High Purity Gas Distribution Systems," *IEEE Transactions on Components, Hybrids and Manufacturing Technology*, 14 (3), 507 (1991).

- Governal, R. A., Yahya, M., Gerba, C., and Shadman, F., "Oligotrophic Bacteria in Ultra-Pure Water Systems: Media Selection and Process Component Evaluation," *Journal of Industrial Microbiology*, 8, 223 (1991).
- Governal, R.A., Bonner, A.L., and Shadman, F., "Effect of Component Interactions on the Removal of Organic Contamination from Ultra-Pure Water Systems," *IEEE Transactions on Semiconductor Manufacturing*, 4 (4), 298 (1991).
- Zhao, Y. and Shadman, F., "Reduction of Ilmenite with Hydrogen," *Industrial and Engineering Chemistry Research*, 30 (9), 2080 (1991).
- Uberoi, M. and Shadman, F., "High Temperature Removal of Cadmium Compounds Using Solid Sorbents," *Environmental Science and Technology*, 25 (7), 1285 (1991).
- Uberoi, M. and Shadman, F., "Simultaneous Condensation and Reaction of Metal Vapors with Porous Solids," *Industrial and Engineering Chemistry Research*, 30 (4), 624 (1991).
- Uberoi, M. and Shadman, F., "Sorbents for Removal of Lead Compounds from Hot Flue Gases," *AIChE Journal* 36 (2), 307 (1990).
- Zhao, Y. and Shadman, F., "Kinetics and Mechanisms of Ilmenite Reduction with Carbon Monoxide," *AIChE Journal*, 36 (9), 1433 (1990).
- Uberoi, M. Punjak, W.A., and Shadman, F., "The Kinetics and Mechanism of Alkali Removal From Flue Gases by Solid Sorbents," *Progress in Energy and Combustion Science,* 16, 205 (1990).
- Punjak, W.A., Uberoi, M., and Shadman, F., "High-Temperature Adsorption of Alkali Vapors on Solid Sorbents," *AIChE Journal* 35 (7), 1186 (1989).
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- Shadman, F., Sams, D.A., and Punjak, W.A., "Significance of Alkali Carbonate Reduction in Catalytic Carbon Gasification," *Fuel* 66 (12), 1658 (1987).
- Morris, R.E. and Shadman, F., "Control of Sulfur Oxides Emission During the Roasting of Lime-Coated Metal Sulfide Pellets," *Chem. Eng. Sci.* 42 (1), 9 (1987).
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- Bissett, E.J. and Shadman, F., "Thermal Regeneration of Diesel-Particulate Monolithic Filters," *AIChE Journal* 31 (5), 753 (1985).
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- Shadman, F. and Petersen, E.E., "Co-Crystallization of Isomorphic Substances," *Chemical Engineering Science* 29, 191 (1974).
- Shadman, F. and Petersen, E.E., "The Effect of Catalysts on the Deflagration Limits of Ammonium Perchlorate," *Combustion Science and Technology* 5, 61 (1972).
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**Recent Industrial Short Courses:**

- Sustainability Challenges and Opportunities in High-Technology Industries, INMETRO, Rio, Brazil, August 2012
- Water and Energy Usage and Conservation Issues in High Technology Industries, Short course at South China University of Technology, November 17-18, 2008
- Environmentally Benign Manufacturing in Nano-scale, short course organized by ISSM, Japan, Tokyo, Japan October 27-28, 2008
- Cleaning and Drying of Patterned Wafers, Nano-structures, and Porous Film for SC Manufacturing; Intel telecast short course, May 2007
- New Materials and Processes for Environmentally Benign Manufacturing of Micro- and Nano- Structures; sponsored by ITRI, Hsinchu, Taiwan, September 2004.

- Surface Preparation in Semiconductor Manufacturing: Tools and Techniques for Water, Energy, and Chemicals Use Reduction; sponsored by ITRI, Hsinchu, Taiwan, October 2003.
- Surface Cleaning Technologies: Fundamentals and Best Practices; sponsored by Pall Corp, Fujimi Corp, and Saitama University, Japan, April 2002.
- Waste Minimization in Chemical Mechanical Planarization of Copper and Dielectrics for Semiconductor Fabs; sponsored by USAEP, Singapore, July 2001.
- Review of Fundamentals and Applications of New Materials for Modern Semiconductor Manufacturing; Atofina, May 2001.
- Fundamentals of CMP and Post-CMP Wafer Rinsing and Cleaning; co-sponsored by ITRI and TSMC, Hsinchu, Taiwan, November 2000.
- Water Purification and Wastewater Treatment Technology; Seoul, Korea, March 2000.
- ESH Aspects of New Dielectric and CMP Materials; technology transfer short course at Hitachi Chemicals, Tokyo, Japan, March 2000.

**Keynote, Invited, and Award-Winning Presentations Since 1985:**

- Environmental Challenges and Opportunities in Nano-Electronics Manufacturing, *invited talk*, CalTech, April 2011
- Manufacturing in Nano-Scale: Environmental Challenges and Opportunities, *Distinguished Speakers Lecture Series*, University of Utah, March 2011
- Sustainability Aspects of High-Performance Materials and Processes, *invited talk*, 10th International Nanotechnology Conference, Tokyo, February 17, 2011
- Environmental Challenges and Opportunities for Nano-Manufacturing of Electronic Devices**,** *invited talk*, EPA, Cincinnati, July 2010
- Environmental Challenges Related to Scaling in Microelectronics and Photonics Industries, ***keynote conference opening talk***, ISSM Annual Meeting, Shanghai, China, March 2008
- Green Manufacturing Easier or More Difficult in Nano-Scale, ***Keynote talk***, ITPC Annual Conference, Maui, November 2007
- Novel Technologies for Surface Preparation in Semiconductor Manufacturing, *invited presentation*, Samsung Corp, Seoul, Korea, June 2007
- Environmental Challenges and Opportunities in Nano-Scale Manufacturing of Future Electronics, ***keynote talk,*** 14th Annual ISESH Conference, Jeju, Korea, June 2007
- Sustainability Challenges and Opportunities in Nano-Scale Manufacturing, *invited presentation*, CCMS International Conference, Porto, Portugal, May 2007
- Environmental Challenges and Opportunities in Nanoelectronics Manufacturing, *invited presentations*, 3rd International Nanotechnology Conference (INC3), Brussels-Belgium, April 2007
- New Technologies for Ultra-Purification of Water Used for Nano-Manufacturing, *invited presentation*, NATO Clean Products and Processes International Conference, Istanbul, Turkey, June 2006
- Research Frontiers in Semiconductor Manufacturing: Opportunities for Chemical Science and Engineering, ***invited talk in plenary session***, 27th Annual Meeting; The Council for Chemical Research, Tucson, Arizona, May 1, 2006

- Environmental Challenges and Opportunities in Nano-Manufacturing, ***keynote talk,*** Green Nanotechnology Project on Emerging Nanotechnologies; Woodrow Wilson International Center for Scholar, Washington *DC*, April 26, 2006
- Environmental and Sustainability Challenges of Future Nano-Electronics and Photonics Technology and Manufacturing, ***plenary talk***, NATO Clean Products and Processes International Conference, Alesund, Norway, June 2005
- Sustainability: A Technology Driver in Semiconductor and Nano-scale Manufacturing, *invited presentation*, University of Pittsburgh, PA, April 2005
- Potential Environmental Issues in Nano-Manufacturing, *invited presentation,* NSF/SRC Silicon and Beyond Conference, Washington DC, December 2004.
- Use of Additive Processing in Nano-Manufacturing, *invited presentation,* NNIN workshop, NSF National Nanotechnology Infrastructure Network, Georgia Tech, December 2004.
- Environmental Challenges and Opportunities in Nanotechnology, *invited presentation*, University of Kentucky, October 2004.
- Additive instead of Subtractive Processing for Future Semiconductor Manufacturing; *invited presentation*, AVS 50$^{th}$ National conference, November 2003.
- Environmental Gain through Process Integration: An Overview and Perspective; *invited presentation*, SEMICON West, July 2003.
- Challenges in the Application of New Materials for 0.1-micron Technology and Beyond; *invited presentation*, ITRI, Taiwan, December 2002.
- Additive Processing: A Key Step in Environmentally Benign Semiconductor Manufacturing; ***Akira-Inoue Award keynote address***, SEMICON Japan, Tokyo, December 4, 2002.
- Impact of Design for Environment on Future Technology Trends in Semiconductor Manufacturing; ***keynote address,*** 9$^{th}$ Annual Conference of ISESH, San Diego, June 2002.
- Novel Separation Technologies for Water Purification and Wastewater Treatment in Semiconductor Fabs; ***keynote address, plenary session***, 15$^{th}$ annual SPWC Conference, Monterey, California, March 2001.
- ESH as a Driver for Introduction of New Materials in Semiconductor Processing; *invited presentation*, International Forum on Semiconductor Technology; IMEC, Belgium, March 2001.
- New Materials and Processes for FEOL in Semiconductor Manufacturing; *invited presentation*, North Carolina State University, November 2000.
- Environmental Challenges and New Developments in Semiconductor Manufacturing; *invited presentation*, ITRI, Taiwan, November 2000.
- Environmental Challenges in Semiconductor Manufacturing; *invited presentation,* symposium series, University of California in Dan Diego, April 2000.
- PFC and VOC Emission: Issues and Research Frontiers, *invited presentation*, NATO/EPA International LCA Conference, Copenhagen, May 2000.
- Implementation of Design for Environmental Concept in Modern Semiconductor Processing, *invited presentation,* symposium series, University of California in Los Angeles, April 2000.

- The Role of Environmental Drivers in Shaping Future Semiconductor Manufacturing; ***keynote address, plenary session***, SPIE Microlithography Conference, Santa Clara, February 2000.
- Fundamentals of Rinsing and the Integration with Water Usage and Quality; *invited presentation*, 5th International Symposium on Ultra Clean Processing of Silicon Surfaces, Oostende, Belgium, September 2000.
- Integrated Approach to ESH issues in Semiconductor Manufacturing; ***keynote address***, Annual Conference of ISESH, Williamsburgh, June 1999.
- Examples of Factory Integration Solution to Environmental Issues; *invited presentation,* at IMEC, Belgium, June 1999.
- Role of Environmental Drivers in Shaping the Future Semiconductor Processes; *invited presentation*, Annual AVS Conference, Seattle, October 1999.
- Review of Factory Level ESH issues in Modern Fabs: ERC Approach; *invited presentation*, Pall Corporation, New York, November 1999.
- UPW Process Design and Advance Control Strategies; *invited presentation*, Bell Lab, New Jersey, October 1999.
- Water and Energy Issues in Modern Semiconductor Manufacturing; *invited presentation,* University of Stuttgart, Germany, October 1999.
- Use of Process Simulation for Integrated Metrology and Control of Trace Impurities in UPW Systems; *invited presentation*, Lucent, Orlando, November 1998.
- Review of Chemical Usage and Selection Challenges in Semiconductor Industry*; invited presentations*, Elf Atochem, King of Prussia, September 1998.
- Fundamental Mechanism and Kinetics of Silicon Wafer Contamination by Moisture and Organics; co-authored and presented by Mohith Verghese, *best paper award*, Techcon Annual Conference, Las Vegas, September 1998.
- Water and Energy Usage in Modern Semiconductor Manufacturing: Challenges and Opportunities; *invited presentation*, Annual International ESH Conference, Kyongju, Korea, May 1998.
- Water Conservation and Recycling in Semiconductor Manufacturing Plants: Technical Challenges and Potential Solutions; ***keynote address***, SPWCC International Conference, March 98.
- Environmental Issues in Modern Semiconductor Manufacturing Sites; *invited presentation*, NATO International meeting on Clean Processes and Products, EPA, Cincinnati, March 1998.
- Environmental Issues in Semiconductor Manufacturing: Challenges and Opportunities" ***keynote address***, Semicon Taiwan, September 1997.
- Mechanism and Kinetics of Adsorption and Desorption of Moisture on Silicon and Silicon Dioxide; co-authored and presented by Eric Shero, *best paper award*, Techcon Conference, Calif., September 1997
- Water recycling Technology for Modern Semiconductor Fabs., *invited presentation and tutorial*, Industrial Technology Research Institute, Taiwan, September 1997.
- Application of Design for Environment Concepts in Semiconductor Manufacturing; *invited seminar series speaker*, Illinois Institute of Technology, May 1997.
- Technology Gaps for ESH Research in Semiconductor Manufacturing, *invited speaker*, Texas Instruments, Dallas, October 1996.
- Ultra-Purification of Water: A new Challenge for Semiconductor Industry; *invited*

*speaker*, Motorola, Phoenix, April 1997.

- UPW Purification and Filtration Requirements of Semiconductor Industry, *invited presentation and tech transfer review*, Pall Corporation, Dec 1997.
- Environmental Issues Related to Plasma and Metallization Processes in Semiconductor Manufacturing, *invited presentation*, Industrial Ecology Symposium, Bell Laboratories, Murray Hill, NJ, June 1997.
- The ESH Technology Roadmap the Research Requirements for Modern Fabs, *invited presentation*, Advanced Micro Devices, Sunnyvale, California, May 1997.
- Water Recycling in Semiconductor Industry, ***keynote address***, SPWCC Conference, Santa Clara, March 1996.
- ESH Issues Related to Advanced Materials and Methods in Semiconductor Processing; *invited presentation*, ChE Department, University of New Mexico, April 1996.
- Design for Environment in Semiconductor Processing; *invited presentation*, ChE Department, University of Southern California, May 1996.
- Transport and Distribution of Trace Gaseous Impurities in Delivery Systems and Process Tools, *invited presentation* Ultra-Clean Society Annual Meeting, Tokyo, Japan, December 1995.
- Control of Process Generated Impurities in Water Recycling Loops of Ultra-Pure Water Systems, *invited presentation*, Motorola Environmental Workshop, Phoenix, AZ, April 1995.
- Control of Process Generated Impurities in Water Recycling Loops of Ultra-Pure Water Systems, *invited presentation*, SEMATECH Environmental Workshop, Austin, TX, February 1995.
- Transport and Distribution of Gaseous Contaminants in Process Tools, *invited presentation*, Ultra-Clean Society Meeting, Tokyo, Japan, December 1995.
- Control of Molecular Contaminants During Semiconductor Processing, *invited presentation*, ChE Department, California Institute of Technology, Pasadena, CA, October 1994.
- Permeation of trace Moisture in Polymers: Measurement and Control, *invited presentation*, NIST Symposium on Moisture in Ultra Clean Systems, Gaithersburg, MD, May 1994.
- Novel Concepts in Water Recycling and Reuse in Semiconductor Fabs, ***keynote address*****,** Water Management and Conservation Symposium, Sematech/SSA, San Jose, California, March 1994.
- Sorbents for Purification of Gas Mixtures, *invited presentation*, Pall Corporation Research Lab., Cortland, NY, November 1993.
- Reactive Membranes for Removal of Trace Contaminants from Fluids, *invited presentation*, EPA, Cincinnati, OH, April 1993.
- Application of APIMS in Developing Methods for Controlling Gaseous Impurities," co-authored and presented by Asad Haider, *Best Presentation Award*, Motorola Scientific Advisory Board Associates (SABA) Conference, Orlando, Florida October 1992.
- Integrated Approach to the Removal of Impurities from Gases and Water in the Microelectronic Industries, *invited presentation*, Electrochemical Society, Toronto, Canada, October 1992.
- Low and Sub-ppb Level Purification and Analysis for Ultra-pure Gases, *invited presentation*, Millipore Corporation, Bedford, Mass., February 1992

- New Methods for Removing Trace Contaminants from Gases and Water, *invited presentation*, Pall Corporation Research Laboratories, New York, April 1992.
- New Methods for Removal of Organic Impurities in Water, *invited presentation*, Motorola Defect Density Conference, Phoenix, Ariz., December 1991.
- Novel sorbents and Sorption Systems for Removal of Trace Impurities from Gases," *invited presentation*, University of Washington, Seattle, WA, April 1991.
- Adsorption/Desorption of Moisture on Ceramic Filters in High Purity Gas Distribution Systems; co-authored by Asad Haider, *best paper of the conference award*, IEEE Meeting, Washington DC, October 1990.
- Application of Chemical Reaction Engineering in Difficult Separation and Purification Processes, *invited presentation*, W.R. Grace Research Laboratories, October 1990.
- Mechanism of Ilmenite Reduction with Carbon Monoxide; co-authored by Yi Zhao and Gary Chandler, *best paper award*, Society for Electron Microscopy and Microbeam Analysis, Tucson, February 1990.
- Novel Techniques for Removal of Soot Particles from High-Temperature Flue Gases, *invited presentation* at the Engelhard Research Laboratories, March 1990.
- Reactive Membranes for Removal of Impurities from Ultra-Pure Fluids in Semiconductor Industries, *invited presentation*, Motorola Annual Technical Workshop, Phoenix, December 1989.
- Control of Alkali Compounds during Coal Combustion and Gasification, *invited presentation* at the Patten Chemical Engineering Colloquium Series, University of Colorado, Boulder, Colorado, April 1988.
- Novel Adsorbents and Adsorption Processes, *invited presentation* at the National Bureau of Standards, Boulder, Colorado, April 1988.
- Use of Solid Adsorbents for Control of Alkali Metals in Coal Conversion Systems, *invited presentation* at the Coal Alkali Workshop, DOE, Morgantown Energy Technology Center, West Virginia, August 1987.
- Studying the Pathway of Carbon Gasification Reactions by a novel Programmed Transient technique, *invited presentation*, University of California, San Diego, California, October 1986.

**Patents and Licensed Inventions:**

- Vermeire, B and Shadman, F., "Shielded Micro Sensor and Method of Electrochemically Monitoring Residue in Micro Channels," US Patent # 7317317; issued in 1-9-08.
- Vermeire, B and Shadman, F., "Micro Sensor and Method for Electro-Chemically Monitoring Residue in Micro Features," patent application 11,205,636 filed, August 2005.
- Vermeire, B and Shadman, F., "Surface Micro Sensor and Method," patent application 11,205,635 filed, August 2005.
- Shadman, F., and Vermeire, B., "Electrochemical Residue Sensor," provisionary patent application filed, September 2004.
- Shadman, F., Kin, K., Chang, P., Cheng, H. "Process for Removing Organics from Ultra-Pure Water", patent application filed, December 2003.
- Shadman, F., Kin, K. "Contacting Method for Ozonated Water Removal of Organic Contaminants from Wafer Surfaces," patent application jointly with ITRI, October 2003

- Philipossian, A. and Shadman, F., “Novel Apparatus for Pad Conditioning and Slurry Re-Claim in Chemical Mechanical Polishing,” patent disclosure UA02-087
- Shadman, F. “A comprehensive Numerical Simulator for Ultra-Pure Water Production and Distribution Systems” copyright, licensed to Sematech and commercialized (November 2000).
- Shadman, F., “Membranes with Non-Uniform Distribution of Photo-Catalytic Sites for Ultra-Purification of Water” patent disclosure, UA (February 2000)
- Zachariah, M. and Shadman F., “Method for Measuring Surface Concentration of Particles and Adsorbents,” patent disclosure, UA (June 1998)
- Shadman, F. “A Novel Technique for Simultaneous Oxidation and Degasification of Organic Impurities for Water Purification,” licensing agreement with Pall Corp (February 1998).
- Shadman, F., “Reactive Membrane for Filtration Purification of Gases of Impurities and Method Utilizing the Same,” US patent 5,637,544 (June 1997); licensed and commercialized.
- Shadman, F., “Reactive Filters for Purification of Gases of Impurities,” US patent 5,635,148 (June 1997), licensed and commercialized.
- Shadman, F., “Novel Catalytic Membrane Chemistry and Configuration for Ultra-Purification of Water,” patent disclosure (November 1997).
- Shadman, F. and Governal, R., "UV Treatment Unit Equipped with a Catalytic Membrane Filter for Removal of Organic Impurities from Water," US patent 5,302,356 (April 1994).
- Shadman, F., "A Novel Ceramic Filter for Hot Gas Purification," patent disclosure UA590 (April 1993).
- Shadman, F., "Reactive Membranes for Filtration and Purification of Gases of Impurities," US Patent 5,196,380 (March 1993), licensed and commercialized
- Shadman, F., "A New Method for On-Line Measurement and Characterization of Trace Impurities in water," patent disclosure UA552 (June 1991).
- Shadman, F. and Wendt, J.O.L., "A Novel Method for the Carbothermal Production of Aluminum Nitride," patent disclosure CH-UA226 (March 1989).
- Shadman, F., "Preparation of a Highly Porous and Activated Material from Low-Cost Carbonaceous Materials," patent disclosure UA 736, December 1984.
- Shadman, F. and Hegedus, L.L., "Diesel Exhaust Filter-Incinerator," US patent 4,329,844 (May 1982).
- Shadman, F. and Hegedus, L.L., "Incineration-Cleanable Composite Exhaust Filter and Vehicle Equipped Therewith," US patent 4,346,557 (August 1982).

**Recent Consulting:**

- Arkema, Inc. (2003- ); novel slurry chemistries for copper planarization
- ASM America (2002- ); atomic layer CVD process optimization and reactor design.
- ST Microelectronics (2002-); contamination control in ultra-pure water systems.
- Atofina and Elf Atochem, France and Pennsylvania (1998-99); novel applications for fluorinated polymeric materials.
- MER Corporation, Arizona (2000-2001); membrane micro-reactors for combinatory reaction studies.

- Pall Corporation, New York (1992-); various aspects of contamination control in gases and liquid.
- Sematech, Texas (1993-); process simulation and recycle in UPW systems.
- Meeco Corporation/Tiger Optics Inc., Pennsylvania (1999-); member of the Corporate Technical Advisory Board.
- Motorola, Phoenix (1995-98); water recycling in semiconductor fabs.
- Intel, Oregon and Arizona (1994-97); control of gaseous contaminants in gas distribution systems.

**Selected Extramural Professional Activities:**

- *Co-Founder and President*, Environmental Metrology Corporation, Arizona (2003-).
- *Member*, Board of Directors, Tiger Optics Corp, Pennsylvania (1999- ).
- *Member:* Technology Roadmap for Semiconductor Industry; Committees on Contamination and Defect Control (1997-2001) and on ESH (1997-).
- *Member*: Sematech Program Technical Advisory Board on Water Use and Reuse in Semiconductor Industry (1991-2001).
- *Editorial Board Member:* Journal of Clean Products and Processes (1999-2002).
- *Session Chair, Symposium Organizer, and Member of Program Committee in Various National and International Meetings*: AIChE, ACS, SPIE, IEEE, IES, MRS, SPWCC, ECS.

**Selected Service Activities at the University of Arizona:**

- Member of the Search Committee, President of the University of Arizona (2005-)
- Member of the Search Committee, Vice President for Research, University of Arizona (2005)
- Member of the Search Committee, Chemical and Environmental Engineering Department Head (2005-)
- Chairman of the Promotion and Tenure Committee, Chemical and Environmental Engineering Department (1994-1997); Member (1994-)
- Member of the Directors Committee managing TRIF state funding of the university-wide water substantiality research program (2001-)
- Member of the Search Committee, Dean of the College of Engineering (1997-1998)
- Chairman of the Faculty Search Committee, Chem./Environ. Eng. Dept. (1994-1999)
- Chairman of the Search Committee, Chemical Engineering Department Head (1990).
- Chairman of the Graduate Studies Committee, Chem. Eng. Dept. (1984-1987 and 1991-1994); member (1981- 1996).

**Research Grants Since 1985:**

- Engineering Research Center for Environmentally Benign Semiconductor Manufacturing, *SRC and industrial members* $1.7 M/year (2012-2015).
- Defect Reduction in Mega-sonic Cleaning, *National Science Foundation*, jointly with Profs Deymier and Raghavan; $299,193 (2009-2012)
- Engineering Research Center for Environmentally Benign Semiconductor Manufacturing, *National Science Foundation, SRC and Sematech* $2.4 M/year (2006-2011).

- Engineering Research Center for Environmentally Benign Semiconductor Manufacturing; industrial membership $600k (2005-2012); in-kind donations over $1M/year.
- Environmentally-friendly high-dielectric materials and processing technique for advanced CMOS devices, Sematech, $100k (2005).
- Development of New Chemistries as Replacement for IPA in Wafer and Chamber Cleaning during Semiconductor Manufacturing; Intel Corporation, $125k (2004-2005).
- Educational Research Grant for Development of Web-Based Course Modules in Environmental Aspects of High-Technology Industries; cost shared by industry and a special State of Arizona initiative, $120k/year, (2001-2005).
- Engineering Research Center for Environmentally Benign Semiconductor Manufacturing, *National Science Foundation*, $1.5 M/year (2001-2004); $1M (2004-2005); $750k (2005-2006).
- Engineering Research Center for Environmentally Benign Semiconductor Manufacturing, *Semiconductor Research Corporation, SIA, and Sematech* $1.5M/year (2001-2006); approved a base of $2M/Year (2007-).
- Educational Research Grant, *National Science Foundation*; jointly with Prof. Kim Ogden, $101,750 (1999-2001).
- Synthesis of Novel Catalytically-Active Fluorinated Organic Membranes, *Pall Corporation*, $50,000 (2001-2002).
- Removal of Residual Contamination from Wafer surfaces, *Semiconductor Research Corporation*, $50,000 (2000-2001).
- Catalytic Removal of Organic Impurities from UPW, *Semiconductor Research Corporation*, $28,214 (2000-2001).
- Research Experience for Undergraduate Students, *Semiconductor Research Corporation*, $24,000 (2000-2001).
- Adsorption and Desorption of Moisture on Wafer Surfaces During the Outgassing and Purge Process, *Semiconductor Research Corporation*, $114,013 (1998-1999).
- Novel Process Simulation Technique in Design for Environment, *National Science Foundation*; jointly with Prof. Gary Rubloff, U. Maryland, $400,000 (1998-2002).
- Program Expansion Funding, Engineering Research Center for Environmentally Benign Semiconductor Manufacturing, *National Science Foundation*, $367,000 (1998-2001).
- UPW Process Simulator for Water Recycling in Semiconductor Fabs, *Sematech*, $125,000 (1998-2001).
- Water Use and Recycle Optimization, *Sematech*, $50,000 (1999-2000); $50,000 (2000-2001).
- Engineering Research Center for Environmentally Benign Semiconductor Manufacturing, *National Science Foundation*, $5,000,000 (1996-2001).
- Engineering Research Center for Environmentally Benign Semiconductor Manufacturing, *Semiconductor Research Corporation*, $5,000,000 (1996-2001).
- Engineering Research Center for Environmentally Benign Semiconductor Manufacturing, Supplement, *National Science Foundation*, $1,101,000 (1998-2001).
- Development of Recycle Simulator for UPW Systems, *International Sematech*, $164,000 (1997-1998).
- Trace Analysis in Vertical thermal Reactors: Graduate Fellowship; *Semiconductor Research Corporation*, $32,800 (1996-1998).

- Research Experience for Undergraduates, *National Science Foundation*, Jointly with Dr. K. Ogden $ 56,500 (1996-1998).
- Kinetics and Mechanism of Moisture Interactions with the Layered Structure of Anodized Aluminum, *Center for Micro-Contamination Control*, UA $ 55,993 (1995-1996).
- Novel Membrane Materials and Processes for Low-Energy Purification Method and Recycling of Ultra-pure Water for Semiconductor Rinsing Applications, *US Environmental Protection Agency*, $300,094 (1994-1998).
- New Sorbents for Removal of Sulfur and Metallic Compounds from High-Temperature Gases, *VTT*, $ 46,000 (1994-1996).
- Multi-Component Impurity Profile Mapping in Recycled UPW Systems, *Semiconductor Research Corporation/Sematech*, $182,052 (1994-1995).
- Metrology and Control of ppb and Sub-ppb Level Impurities in Gases; *ARPA through Sandia National Laboratory*, $400,000 (1993-1996).
- Multi-Component Impurity Profile Mapping in Recycled UPW Systems, *Sematech*, $162,908 (1993-1994).
- High Temperature Reactions of Silicates with Reducing Gases; *NASA* $152,800 (1992-1994).
- Effect of Surface Passivation on Adsorption of Moisture on Stainless Steel, *Semi-Gas, Matheson*, $5,000 (1994).
- Novel Reactive Filters for Removal of Contaminants from Fluids; *Pall Corporation*; $100,000 (1992-1993).
- Development of a Calibration Method for Trace Analysis in Gases; *MKS Corporation*; $35,000 (1992).
- Development of a Trace Analysis Laboratory; *Semiconductor Research Corporation, SEMATECH*; $26,812 (1992-1993); *University of Arizona* $40,000 (1992-1993).
- Comparison of APIMS Technique with Dedicated Analyzers for Trace Analysis; *Meeco, Inc.*; Equipment donation, $30,000 (1992).
- Ultra-purification of Water for Semiconductor Manufacturing; student fellowship; *IBM Manufacturing Research Graduate Fellowship*; $14,140 (1991-1992).
- Development of APIMS Techniques for Trace Gaseous Analysis; *Motorola*; University/Industry Partnership Program; $19,014 (1991-1992); $19,014 (1992-1993).
- Interactions of Gaseous Impurities with Ceramic, Metallic and Polymeric Filter Substrates; Jointly with Stephen Gilbert; *Center for Microcontamination Control*; $49,404 (1992-1993).
- Production of Oxygen from Iron-Bearing Space Minerals; *NASA, Center for Utilization of Local Planetary Resources*; $106,483 (1991-1992).
- Adsorption and Desorption of Gaseous Impurities on Ceramic Filters; Jointly with Stephen Gilbert; *Center for Microcontamination Control*; $43,525 (1991-1992).
- Interactions of UV and Ozone During Oxidation of TOC in Ultra-Pure Water; *Semiconductor Research Corporation, SEMATECH*; $63,006 (1991-1992); $95,605 (1992-1993).
- Control of Trace Impurity Distribution in Ultra-Pure Gas Distribution Systems; *Semiconductor Research Corporation, SEMATECH*; $87,000 (1991-1992); $100,868 (1992-1993).
- Design and Construction of a Test Unit for APIMS; *Intel*; $35,000 (1991).

- Adsorption and Desorption of Trace Impurities in Ultra-Pure Gas Distribution Systems; *Semiconductor Research Corporation, SEMATECH*; $61,265 (1990-1991).
- Interactions of UV and Ozone during Oxidation of TOC in Ultra-Pure Water; *Semiconductor Research Corporation, SEMATECH*; $77,238 (1990-1991).
- Effect of Impurities on the Kinetics and Mechanism of Hydrogen and Carbothermal Reduction of Ilmenite; *NASA, Center for Utilization of Local Planetary Resources*; $101,667 (1990-1991).
- Atmospheric Pressure Ionization Mass Spectrometer for Trace Analysis in Gases Used in Semiconductor Manufacturing: An Instrumentation Grant; *Semiconductor Research Corporation, Sematech*; $350,000 (1989-1990).
- Application of Atmospheric Pressure Ionization Mass Spectrometer for Trace Analysis in Gases in Semiconductor Manufacturing: *University of Arizona*; $40,000 (1989-1990).
- Synergistic Capture Mechanism for Alkali and Sulfur Species from Combustion; with Drs. T.W. Peterson and J.O.L Wendt; *US Department of Energy*; $199,977 (1990-1993).
- Reactive Membrane for Removal of Impurities from Gases in Semiconductor Industries; *Sematech*; $98,000 (1989-1990).
- Interactions of UV and Ozone during Oxidation of TOC in Ultra-Pure Water; *Semiconductor Research Corporation, SEMATECH*; $87,500 (1989-1990).
- Kinetics and Mechanism of CO and $H_2$ Reduction of Lunar Ilmenite; *NASA, Center for Utilization of Local Planetary Resources*; $95,579 (1989-1990).
- Reactive Filters for Removal of Impurities from Fluids in Semiconductors Processing; *Semiconductor Research Corporation, SEMATECH*; $118,446 (1988-1989).
- Catalytic Carbothermal Reduction for Production of Oxygen from Lunar Ilmenite; *NASA, Center for Utilization of Local Planetary Resources*; $71,096 (1988--1989).
- Utilization of Coal Ash Minerals for Technological Ceramics; with Dr. S. Risbud of Materials Science and Engineering Department; *US Department of Interior, MMRRI*; $15,680 (1987-1988).
- Mechanism of Surface Enrichment and Adhesion of Coal Combustion Particulates; with Drs. T.W. Peterson and J.O.L. Wendt; *US Department of Energy*; $174,975 (1986-1989).
- Production of Aluminum Nitride from Bauxite Using a Carbo-nitridation Process; *Keramont Research Company and University of Arizona*; $2,500 (1987-1988).
- Effect of Minerals Stratification on Aluminum Recovery from Coal Ash Particles; with Drs. T.W. Peterson and J.O.L. Wendt; *US Department of Interior, MMRRI*; $16,030 (1986).
- Sulfur Recovery from the Scrubber Solid Residue in Coal Combustors: A Feasibility Study; *Northern States Power Company*, $7,000 (1985-1986).
- A Novel Process for the Production of Metallurgical Coke from Coal; *US Department of Interior*; $17,071 (1985-1986).
- Scanning Auger Microprobe for Particle Analysis; with Drs. T.W. Peterson and J.O.L. Wendt; *US Department of Energy*; $279,000 (1985).

**Post-Doctoral Fellows and Research Associates Supervised:**

| | |
|---|---|
| Reza Dodge | (2012- ) |
| Jeongnam Han | (2008- ) assignee from Samsung Corp |
| Jacky Yao | (2008- ) |
| Jun Yan | (2007- ) |
| Jun Pilkwon | (2006-2007) assignee from Samsung Corp |
| Bert Vermeire | (1999- 2005) |
| Yun Zhuang | (2002- 2005) jointly with Prof. Philipossian |
| Morvin Johnson | (1998-2001) jointly with Prof. Ogden |
| Gholam Ehteshami | (1996-1999) |
| Keijo Jaanu | (1997-1998) |
| Ce Ma | (1991-1995) |
| Andy Cutler | (1991-1993) |
| Werner Hahn | (1981-1982) |

**Graduate Students Supervised:**

| | | |
|---|---|---|
| Jivaan Jhothiraman | PhD | (expected 2015) |
| Roy Dittler | PhD | (expected 2013) |
| Luis Carlos Platt | PhD | (expected 2014); co-advised by Prof. Sierra |
| Davoud Zamani | PhD | (expected 2012) |
| Hao Wang | PhD | (expected 2012) |
| Jeff Rottman | PhD | (expected 2012); co-advised by Prof. Sierra |
| Lisa Lowe | MS | (August 2012) |
| Kedar Dhane | PhD | (2010) presently with Intel |
| Jacky Yao | PhD | (2009) presently with Matheson |
| Harpreet Juneja | PhD | (2008) presently with AMAT |
| Asad Iqbal | PhD | (2007) presently with Intel |
| Kai Chen | MS | (2007) presently at UT |
| Mike Schmotzer | PhD | (pending) presently with ASM |
| Jun Yan | PhD | (2007) presently with Lam Research |
| Baochun Wu | PhD | (pending) presently with IBM |
| Elizabeth Castro | PhD | (2006) presently with Intel |
| Chris Yim | MS | (2004) presently with AMD |
| Prashant Raghu | PhD | (2003) presently with Micron Technologies |
| Niraj Rana | PhD | (2002) presently with Micron Technologies |
| John DeGenova | PhD | (2002) presently with Texas Instruments |
| Srinivasan Raghavan | MS | (2002) presently with TI (co-advised by Dr. Peterson) |
| Lilliam Mena | MS | (2001) presently with Pharmacia |
| Dawn Lowma | MS | (2000) presently with AMD (co-advised by Prof. Ogden) |
| Dan Seif | MS | (1999) presently with AMD (co-advised by Dr. Peterson) |
| Elena Kirkanova | MS | (1999) presently with IBM |
| Mohith Verghese | MS | (1998) presently with ASM |
| Eric Shero | PhD | (1998) presently with ASM |
| Grey Bohon | MS | (1996) presently with Intel |
| Dietmar Sherer | MS | (1996) presently at the University of Stuttgart, Germany |

| | | |
|---|---|---|
| John Croft | MS | (1996) presently with Intel |
| Majid Mansoori | MS | (1996) presently with Texas Instruments |
| Kon-Tsu Kin | PhD | (1996) presently with ITRI |
| Gary Chen | PhD | (1996) presently with Micron Tech |
| John Wibowo | MS | (1995) presently with NRL, Indonesia |
| Sean Du | PhD | (1996) presently with IDC |
| Nishith Verma | PhD | (1995) Professor ChE, IIT, India |
| Elizabeth May | MS | (1994) presently with Intel |
| Prashant Marathay | MS | (1994) presently with Intel |
| Asad Haider | PhD | (1993) presently with Texas Instruments |
| Robert Governal | PhD | (1992) presently with Cuno |
| Charles Massieon | MS | (1992) presently with US Borax |
| Yi Zhao | PhD | (1991) ChE Department Chairman, WFIT, Taiwan |
| Alison Bonner | MS | (1991) presently with Westinghouse |
| Mohit Uberoi | PhD | (1990) presently with MegTech |
| George Rizeq | PhD | (1990) presently with GE |
| Wayne A. Punjak | PhD | (1988) presently at the Los Alamos National Lab |
| Priscilla E. Dombek | MS | (1986) presently with Oregon State U |
| Robert E. Morris | MS | (1985) presently with Raytheon |
| David A. Sams | PhD | (1985) presently with Davison Chemical Company |
| Kevin Talverdian | MS | (1985) presently with Chevron Research Laboratory |
| Robert H. Hamilton | MS | (1983) presently with Weyerhauser |
| David A. Sams | MS | (1983) presently with Davison Chemical Company |
| Norman L. Cook | MS | (1982) presently with Rockwell International |
| Eli Khorasani | MS | (1976) presently with IBM |
| Mohammed Riazi | MS | (1975) ChE Professor at the Kuwait University |