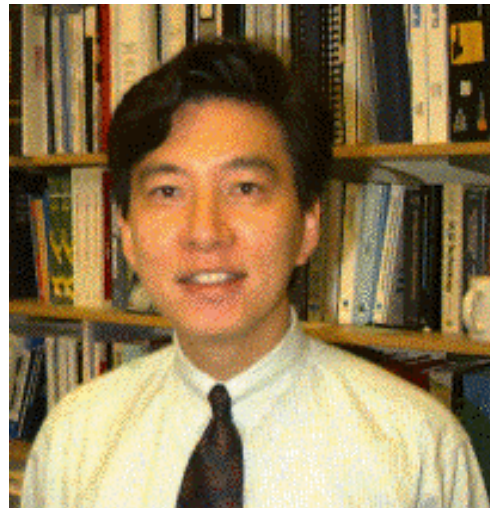

Faculty, Research Staff, and Publications



Professor Judy L. Hoyt



Professor Hae-Seung (Harry) Lee



Professor Clifton Fonstad, Jr.



Professor Akintunde I. (Tayo) Akinwande

Faculty, Research Staff, and Publications

continued

Akintunde I. (Tayo) Akinwande

Associate Professor

Department of Electrical Engineering and Computer Science (EECS)

Collaborators

S. D. Senturia, Barton Weller Professor of
Electrical Engineering, EECS
H. I. Smith, Joseph F. and Nancy P. Keithley Professor
of Electrical Engineering, EECS
T. D. Moustakas, Professor of Electrical Engineering,
Boston University
C. O. Bozler, MIT Lincoln Laboratory
B. R. Johnson, Honeywell Technology Center
R. D. Horning, Honeywell Technology Center
C. Dimitriakopolus, IBM Research

Visiting Scientist

S. Kanemaru, Electro Technical Laboratory (ETL), Japan

Graduate Students

David Pflug, Research Assistant, EECS
Leonard Dvorson, Research Assistant, EECS
Meng Ding, Research Assistant, Physics
Chin-Yin Hong, Research Assistant, MSE
Paul Herz, Research Assistant, EECS
Ioannis (John) Kymissis, IBM Research Fellow
Guo-Bin Sha, Research Assistant, Physics
Belle Wang, Research Assistant, EECS

Administrative Assistant

Carolyn Zaccaria, EECS

Publications

Meng Ding, Han Kim and Akintunde I. Akinwande, "High Uniformity and Low Turn-on Voltage Si FEAs Fabricated with CMP," to be published in *Electron Device Letters*, Feb 2000; 12th International Vacuum Microelectronics Conference Technical Program Digest, IVMC'99, Darmstadt, Germany, July 1999, p. 370.

J. O. Choi, H. S. Jeong, D. G. Pflug, A. I. Akinwande and H. I. Smith, "Fabrication of 0.1 μm gate aperture Mo-tip field emitter arrays using interferometric lithography," *Applied Physics Letters*, Vol. 74, no. 20, 17 May 1999, p. 3050.

Meng Ding, Han Kim and Akintunde I. Akinwande, "Observation of Valence Band Electron Emission from n-type Silicon Field Emitter Arrays" *Applied Physics Letters*, vol. 75, no. 6, 9 August 1999, p. 823; also IEEE 57th Annual Device Research Conference, Santa Barbara, CA, June 1999, p.170.

L. V. Dvorson and A. I. Akinwande, "Molybdenum Field Emitters with Integrated Focusing Electrode," 1999 Society of Information Display International Symposium Digest of Technical Papers, Vol. XXVI, San Jose, CA, May 1999, p. 926.

A. I. Akinwande, B. R. Johnson, B. G. Heil, J. O. Holmen, and D. P. Murphy, "Field-Emission Lamp for Avionics AMLCD," (Invited) 1999 Society of Information Display International Symposium Digest of Technical Papers, Vol. XXVI, San Jose, CA, May 1999, p. 904.

continued

Faculty, Research Staff, and Publications

continued

Dimitri A. Antoniadis

Ray and Maria Stata Professor

Department of Electrical Engineering and Computer Science (EECS)

Graduate Students

M. Armstrong, Research Assistant, EECS

I. Djomehri, Research Assistant, EECS

K. Jackson, Research Assistant, EECS

I. Lauer, Research Assistant, EECS

A. Lochtefeld, Research Assistant, EECS

S. Narendra, Research Assistant, EECS

H. Nayfeh, Research Assistant, EECS

A. Ritenour, Research Assistant, EECS

A. Wei, Research Assistant, EECS

J-H. Lee, G. Taraschi, A. Wei, T. A. Langdo, E. A. Fitzgerald, and D. A. Antoniadis, "Super Self-Aligned Double-Gate (SSDG) MOSFET's Utilizing Oxidation Rate Difference and Selective Epitaxy," *IEDM Digest*, 81-83, December 1999.

Research Staff

C. Gordy, Asst. Director of Administration,
SRC COE in Microsystems Technologies, MTL

Dr. J-H. Lee, Visiting Scientist, Prof. at Sch. of Eng.,
Wonkwang U., Korea.

Dr. D. Song, Post Doctoral Fellow, MTL

Support Staff

E. Munro, Administrative Assistant, MTL

Publications

Lee, Z., M. B. McIlrath, and D. A. Antoniadis, "Two-Dimensional Doping Profile Characterization of MOSFET's by Inverse Modeling Using I-V Characteristics in the Subthreshold Region," *IEEE Transactions On Electron Devices*, **46**, 1640-1649, August 1999.

K. R. Mistry, J. W. Sleight, G. Grula, R. Flatley, B. Miner, L. A. Bair, and D. A. Antoniadis, "Parasitic Bipolar Gain Reduction and the Optimization of 0.25 μm Partially Depleted SOI MOSFET's," *IEEE Transactions On Electron Devices*, **46**, 2201-2209, November 1999.

D. A. Antoniadis, A. Wei, and A. Lochtefeld, "SOI Devices and Technology," *Proceedings of the 29th European Solid-State Device Research Conference*, 81-87, September 1999 (Invited).

continued

Faculty, Research Staff, and Publications

continued

Duane S. Boning

Robert N. Noyce Career Development Associate Professor

Department of Electrical Engineering and Computer Science (EECS)

Undergraduate Students

S. Divecha, EECS

J. Wood, EECS

Graduate Students

A. Amar, LFM Fellow, Sloan & Mech. Eng.

R. Braum, LFM Fellow, Sloan & EECS

H. Chen, Research Assistant, Aero / Astro

R. Dutt, Research Assistant, EECS

T. Gan, Research Assistant, EECS

B. Goodlin, Research Assistant, Chem. Eng.

A. Gower, Research Assistant, EECS

B. Lee, Research Assistant, EECS

V. Mehrotra, Research Assistant, EECS

W. Moyne, Research Assistant, EECS

A. Nishimoto, Research Assistant, EECS

T. Park, Research Assistant, EECS

S. Sam, NSF Fellow, EECS

E. Selvik, LFM Fellow, Sloan & EECS

T. Smith, Research Assistant, EECS

T. Tugbawa, Research Assistant, EECS

D. White, Research Assistant, EECS

B. Wolkenberg, LFM Fellow, Sloan & Material Science

D. White, B. Goodlin, A. Gower, D. Boning, H. Chen, H. Sawin, and T. Dalton, "Low-Open Area Endpoint Detection using a PCA based T2 Statistic and Q Statistic on Optical Emission Spectroscopy Measurements", accepted for publication, *IEEE Transactions on Semiconductor Manufacturing*, Aug. 1999.

T. Smith, B. E. Goodlin, D. Boning, and H. H. Sawin, "A Statistical Analysis of Single and Multiple Response Surface Modeling", *IEEE Transactions on Semiconductor Manufacturing*, vol. 12, no. 4, pp. 419-430, Nov. 1999.

D. S. Boning, B. Lee, C. Oji, D. Ouma, T. Park, T. Smith, and T. Tugbawa, "Pattern Dependent Modeling for CMP Optimization and Control", *Materials Research Society Spring Meeting*, Abstract P5.5, MRS Vol. 566, San Francisco, CA, April 1999.

S. Hymes, K. Smekalin, T. Brown, H. Yeung, M. Joffe, M. Banet, T. Park, T. Tugbawa, D. Boning, J. Nguyen, T. West, and W. Sands, "Determination of the Planarization Distance for Copper CMP Process", *Materials Research Society Spring Meeting*, Abstract P5.6, MRS Vol. 566, San Francisco, CA, April 1999.

T. Smith, S. Fang, J. Stefani, G. Shinn, D. Boning and S. Butler, "Device Independent Process Control of Chemical-Mechanical Polishing, Process Control, Diagnostics, and Modeling in Semiconductor Device Manufacturing III", Abstract No. 213, *195th Electrochemical Society Meeting*, Seattle, WA, May 1999.

H. Sawin, M. Le, B. Goodlin, D. White, A. Gower, and D. Boning, "Control of Plasma Processes Based on Full Wafer Interferometry and Multivariate Spectral Analysis of Optical Emission Spectroscopy, Process Control, Diagnostics, and Modeling in Semiconductor Device Manufacturing III", Abstract No. 232, *195th Electrochemical Society Meeting*, Seattle, WA, May 1999.

Visiting Scientists

H.K. Chung, Samsung Electronics

Support Staff

S. Blake, Administrative Secretary, EECS

Publications

T. Smith, S. J. Fang, J. A. Stefani, G. B. Shinn, D. S. Boning, and S. W. Butler, "On-line Patterned Wafer Thickness Control of Chemical-Mechanical Polishing", *Journal of Vacuum Science and Technology A*, vol. 17, no. 4, pp. 1384-1390, July / Aug. 1999.

continued

Faculty, Research Staff, and Publications

continued

T. H. Smith, and D. S. Boning, "Process Control in the Semiconductor Industry", Quality Engineering in Semiconductor Manufacturing session, *Industrial Engineering Research Conference*, Phoenix, AZ, May 22-23, 1999.

T. Park, T. Tugbawa, D. Boning, S Hymes, T. Brown, K. Smekalin, and G. Schwartz, "Multi-level Pattern Effects in Copper CMP", Third International Symposium on Chemical Mechanical Polishing in IC Device manufacturing, *196th Electrochemical Society Meeting*, Honolulu, HI, Oct. 1999.

S. Hymes, T. Brown, P. LeFevrM, B. Mikkola, R. Bajaj, T. Park, T. Tugbawa, D. Boning, and J. Nguyen, "Modeling of Topography during 1st Step CMP of Cu-Plated Damascene Structures", Third International Symposium on Chemical Mechanical Polishing in IC Device Manufacturing, *196th Electrochemical Society Meeting*, Honolulu, HI, Oct. 1999.

T. Tugbawa, T. Park, D. Boning, T. Pan, P. Li, S. Hymes, T. Brown, and L. Camilletti, "A Mathematical Model of Pattern Dependencies in Copper CMP Processes", Third International Symposium on Chemical Mechanical Polishing in IC Device Manufacturing, *196th Electrochemical Society Meeting*, Honolulu, HI, Oct. 1999.

D. White, D. Boning, and A. Gower, "Characterization of Endpoint and Wafer-Level Non-Uniformity using *In-Situ* Thermography, *Chemical-Mechanical Planarization for ULSI Multilevel Interconnect Conference*, Santa Clara, CA, March 2000.

B. Lee, D. Hetherington, and D. Boning, Using Smart Dummy Fill and Selective Reverse Etchback for Pattern Density Equalization", *Chemical-Mechanical Planarization for ULSI Multilevel Interconnect Conference*, Santa Clara, CA, March 2000.

T. H. Park, T. Tugbawa, and D. Boning, "Overview of Methods for Characterization of Pattern Dependencies in Copper CMP", *Chemical-Mechanical Planarization for ULSI Multilevel Interconnect Conference*, Santa Clara, CA, March 2000.

T. Smith, Fang, S. J., G. B. Shinn, J. Stefani, Z. Tang, S. Chang, S. Garza, J. Campbell, and D. Boning, "Improving Within-Die Nonuniformity in Dielectric CMP", *Chemical-Mechanical Planarization for ULSI Multilevel Interconnect Conference*, Santa Clara, CA, March 2000.

D. S. Boning, J. Stefani, and S. W. Butler, "Statistical Methods for Semiconductor Manufacturing", in *Encyclopedia of Electrical and Electronics Engineering*, vol. 20, pp. 463-479, J. G. Webster, Ed., John Wiley & Sons, 1999.

D. E. Troxel, D. S. Boning, and M. B. McIlrath, "Process Flow Representations for Semiconductor Manufacturing", in *Encyclopedia of Electrical and Electronics Engineering*, vol. 19, pp. 139-147, J. G. Webster, Ed., John Wiley & Sons, 1999.

D. Boning, "A Methodology for Modeling and Characterization of Dielectric CMP Processes", *The CMP Technical Symposium 1999*, pp. 23-38, Tokyo, Japan, June 1999.

T. Smith, S. Fang, J. Stefani, G. Shinn, S. W. Butler, and D. S. Boning, "Device Independent Run by Run CMP Process Control", *The CMP Technical Symposium 1999*, pp. 39-50, Tokyo, Japan, June 1999.

T. Park, T. Tugbawa, D. Boning, and S. Hymes, "Characterization of Pattern Dependent Variation in Copper CMP", *The CMP Technical Symposium 1999*, pp. 79-90, Tokyo, Japan, June 1999.

continued

Faculty, Research Staff, and Publications

continued

Anantha P. Chandrakasan
Associate Professor
Department of Electrical Engineering
and Computer Science (EECS)

D. S. Boning, and O. Ouma, "CMP Modeling and Simulation", in *Chemical Mechanical Polishing in Silicon Processing, Semiconductors and Semimetals*, Vol. 63, Eds. S. H. Li and B. Miller, Academic Press, San Diego, CA, 2000.

D. Boning, T. Park, T. Tugbawa, S. Hymes, and T. Pan, "Modeling of Copper Chemical Mechanical Polishing", *4th Annual Clarkson Workshop on Chemical-Mechanical Polishing*, Lake Placid, NY, Aug. 1999.

N. Poduje, W. Baylies, B. Lee, T. Gan, and D. Boning, "Nanotopology Effects in Chemical Mechanical Polishing", *SEMI-AWG Nanotopology Workshop*, Tokyo, Japan, Nov. 29, 1999.

D. Boning, and S. Nassif, "Models of Process Variations in Device and Interconnect, in Design of High Performance Microprocessor Circuits", Eds. A. Chandrakasan, W. Bowhill and F. Fox, to appear, IEEE Press, 2000.

Graduate Students and Visiting Scientists

Rajeevan Amirtharajah, Research Assistant, EECS
Manish Bhardwaj, Research Assistant, EECS
Charatpong Chotigavanich, Research Assistant, EECS
SeongHwan Cho, Research Assistant, EECS
James Goodman, Research Assistant, EECS
Vadim Gutnik, Research Assistant, EECS
Wendi Rabiner Heinzelman, Kodak Fellow, EECS
James Kao, Research Assistant, EECS
Sam Shiou Lin, NSF Fellow, EECS
Scott Meninger, Research Assistant, EECS
Rex Min, Research Assistant, EECS
Siva Narendra, Research Assistant, EECS
David Rowe, Research Assistant, EECS
Eugene Shih, Research Assistant, EECS
Thomas Simon, Research Assistant, EECS
Amit Sinha, Research Assistant, EECS
Paul-Peter Sotiriadis, Research Assistant, EECS
Travis Furrer, Research Assistant, EECS
Alice Wang, GRPW Fellow, EECS
Thucydides Xanthopoulos, Ph. D.

Support Staff

Margaret Flaherty, Administrative Assistant

Publications

T. Xanthopoulos, A. P. Chandrakasan, "A Low-Power IDCT Macrocell for MPEG2 MP@ML Exploiting Data Distribution Properties for Minimal Activity", *IEEE Journal of Solid State Circuits* (April 1999).

G. Konduri, J. Goodman, A.P. Chandrakasan, "Energy Efficient Software Through Dynamic Voltage Scheduling," *IEEE ISCAS* (May 1999).

A. Chandrakasan, R. Amirtharajah, S. Cho, J. Goodman, G. Konduri, J. Kulik, W. Rabiner, A. Wang, "Design Considerations for Distributed Microsensor Systems", *IEEE Custom Integrated Circuits Conference* (May 1999).

continued

Faculty, Research Staff, and Publications

continued

J. Goodman, A. Dancy, A. P. Chandrakasan, "Design and Implementation of a Scalable Encryption Processor with Embedded Variable DC/DC Converter", IEEE/ACM Design Automation Conference (June 1999).

G. Konduri, A. P. Chandrakasan, "A framework for Collaborative and Distributed Web-based Design" IEEE/ACM Design Automation Conference, (June 1999).

T. Xanthopoulos, A.P. Chandrakasan, "A Low-Power DCT Core Using Adaptive Bitwidth and Arithmetic Activity Exploiting Signal Correlations and Quantization," IEEE Symposium on VLSI Circuits (June 1999).

S. Cho, T. Xanthopoulos, A. P. Chandrakasan, "A Low Power Variable Length Decoder for MPEG-2 Based on Non-Uniform Fine Grain Table Partitioning," IEEE Transactions on Very Large Scale Integration (VLSI) Systems (June 1999).

S. Meninger, J. Mur-Miranda, R. Amirtharajah, A. P. Chandrakasan, J. Lang, "Vibration-to-Electric Energy Conversion," IEEE/ACM International Symposium on Low Power Electronics and Design (August 1999).

R. Amirtharajah, R., T. Xanthopoulos, A. P. Chandrakasan; "Power Scalable Processing Using Distributed Arithmetic," IEEE/ACM International Symposium on Low Power Electronics and Design (August 1999).

A. Sinha, A. P. Chandrakasan, "Energy Efficient Filtering Using Adaptive Precision and Variable Voltage," IEEE ASIC '99 (September 1999).

V. Gutnik, A. P. Chandrakasan, "Distributed Active Clock Network," IEEE European Solid State Circuits Conference (September 1999).

A. Wang, W. R. Heinzelman, A. P. Chandrakasan, "Energy-Scalable Protocols for Battery-Operated Microsensor Networks," IEEE Workshop on Signal Processing Systems (SiPS) (October 1999).

W. R. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Microsensor Networks," Proceedings of the 33rd International Conference on System Sciences (HICSS '00) (January 2000).

R. Amirtharajah, S. Meninger, J. Oscar Mur-Miranda, A. P. Chandrakasan, J. Lang, "A Micropower Programmable DSP Powered Using a MEMS-Based Vibration-to-Electric Energy Converter," IEEE ISSCC (February 2000).

V. Gutnik, A. P. Chandrakasan, "Active GHz Clock Network using Distributed PLLs," IEEE ISSCC (February 2000).

continued

Faculty, Research Staff, and Publications

continued

Jesús del Alamo

Professor

Department of Electrical Engineering and Computer Science (EECS)

Collaborators

P. C. Chao, Sanders Lockheed Martin
A. Cornet, University of Barcelona
D. D'Avanzo, Hewlett Packard
K. G. Duh, Sanders Lockheed Martin
R. Martel, IBM
P. Solomon, IBM
L. Studebaker, Hewlett Packard

Visiting Scientist

J. Appenzeller, Aachen University (Germany)

Graduate Students

R. R. Blanchard, JSEP Fellow, EECS
J. G. Fiorenza, Research Assistant, EECS
S. Mertens, Research Assistant, EECS
J. Wu, Research Assistant, EECS

Undergraduate Students

L. Brooks, EECS
C. McLean, EECS
T. Payakapan, EECS
J. Scholvin, EECS

Support Staff

Eda Munro, Administrative Assistant, MTL

Publications

del Alamo, J. A., M. H. Somerville, and R. R. Blanchard, "Millimeter-Wave InP HEMTs: Challenges and Prospects," *Microwave Engineering Europe*, March 1999, pp. 49-52.

Blanchard, R. R., J. A. del Alamo, and A. Cornet, "Physical Evidence of Hydrogen Degradation of InP HEMTs," 41st Electronics Materials Conference, Santa Barbara, CA, June 1999.

Somerville, M. H., R. Blanchard, J. A. del Alamo, K. G. Duh, and P. C. Chao, "On-State Breakdown in Power HEMTs: Measurements and Modeling," *IEEE Transactions on Electron Devices* 46 (6), 1087-1093, June 1999.

Blanchard, R., J. A. del Alamo, S. B. Adams, P. C. Chao, and A. Cornet, "Hydrogen-Induced Piezoelectric Effects in InP HEMTs," *IEEE Electron Devices Letters* 20 (8), 393-395, August 1999.

del Alamo, J. A., and M. H. Somerville, "Breakdown in Millimeter-Wave Power InP HEMTs: A Comparison with GaAs PHEMTs," *IEEE Journal of Solid-State Circuits* 34 (9), 1204-1211, September 1999.

Fiorenza, J. G., J. A. del Alamo, and D. A. Antoniadis, "An RF Power LDMOS Device on SOI." 1999 IEEE International SOI Conference, Rohnert Park, CA, October 1999, pp. 96-97.

Somerville, M. H., A. Ernst, and J. A. del Alamo, "A Physical Model for the Kink Effect in InAlAs/InGaAs HEMTs," to be published in *IEEE Transactions on Electron Devices*.

Krupenin, S., R. R. Blanchard, M. H. Somerville, J. A. del Alamo, K. G. Duh, and P. C. Chao, "Physical Mechanisms Limiting the Manufacturing Yield of Millimeter-Wave Power InP HEMTs," to be published in *IEEE Transactions on Electron Devices*.

Appenzeller, J., J. A. del Alamo, R. Martel, K. Chan, and P. Solomon, "Ultrathin 600°C Wet Thermal Silicon Dioxide," *Electrochemical and Solid-State Letters*, 3 (2), 84-86, February 2000.

continued

Faculty, Research Staff, and Publications

continued

Mildred S. Dresselhaus

Institute Professor

Department of Electrical Engineering and Computer Science (EECS)

Collaborators

Jackie Y. Ying, Professor, ChE

Joseph Heremans, Delphi Automotive Systems

Research Staff

Hui-Ming Cheng, Visiting Scientist, Physics

Paola Corio, Visiting Scientist, Physics

Gene Dresselhaus, Francis Bitter Magnet Laboratory

Dmitry Gekhtman, Postdoctoral Fellow

Alessandra Marucci, Visiting Scientist, Physics

Ado Jorio, Visiting Scientist, Physics

Herbert J. Zeiger, Visiting Scientist, Physics

Graduate Students

Marcie R. Black, Research Assistant, EECS

Sandra D. M. Brown, Research Assistant, Physics

S. Cronin, Research Assistant, Physics

Takaaki Koga, Research Assistant, Applied Physics,
Harvard University

Yu-Ming Lin, Research Assistant, EECS

Oded Rabin, Research Assistant, Chemistry

Xiangzhong Sun, Research Assistant, Physics

Publications

R. Saito, T. Takeya, T. Kimura, G. Dresselhaus, and M. S. Dresselhaus, Finite size effect on the Raman spectra of single-wall carbon nanotubes, *Phys. Rev. B* 59, 2388-2392 (1999).

S. D. M. Brown, P. Corio, A. Marucci, M. A. Pimenta, M. S. Dresselhaus, and G. Dresselhaus, Second-Order Resonant Raman Spectra of Single-walled Carbon Nanotubes, *Phys. Rev. B* 61, in press (March 2000).

M. S. Dresselhaus, G. Dresselhaus, X. Sun, Z. Zhang, S. B. Cronin, and T. Koga, Low Dimensional Thermoelectric Materials, *Phys. Solid State* 41, 679-682 (1999).

R. A. Jishi and M. S. Dresselhaus, Vibrational frequencies in C36, *Chem. Phys. Lett.* 302, 533-537 (1999).

M. S. Dresselhaus, Z. Zhang, X. Sun, J. Y. Ying, J.

Heremans, G. Dresselhaus, and G. Chen. Prospects for bismuth nanowires as thermoelectrics, In *Thermoelectric Materials-The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications: MRS Symposium Proceedings, Boston, volume 545*, edited by T. M. Tritt, H. B. Lyon, Jr., G. Mahan, and M. G. Kanatzidis, pages 215-226, Materials Research Society Press, Pittsburgh, PA, 1999.

X. Sun, Z. Zhang, G. Dresselhaus, M. S. Dresselhaus, J. Y. Ying, and G. Chen. Theoretical modeling of thermoelectricity in bismuth nanowires, In *Thermoelectric Materials-The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications: MRS Symposium Proceedings, Boston, volume 545*, edited by T. M. Tritt, H. B. Lyon, Jr., G. Mahan, and M. G. Kanatzidis, pages 87-92, Materials Research Society Press, Pittsburgh, PA, 1999.

Z. Zhang, M. S. Dresselhaus, and J. Y. Ying. Fabrication, Characterization and Electronic Properties of Bismuth Nanowire Systems, In *Thermoelectric Materials-The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications: MRS Symposium Proceedings, Boston, volume 545*, edited by T. M. Tritt, H. B. Lyon, Jr., G. Mahan, and M. G. Kanatzidis, pages 351-356, Materials Research Society Press, Pittsburgh, PA, 1999.

Z. Zhang, X. Sun, M. S. Dresselhaus, J. Y. Ying, and J. Heremans, Electronic transport properties of single crystal bismuth nanowire arrays, *Phys. Rev. B* 61, in Press (2000).

D. Gekhtman, Z. Zhang, and D. Adderton. Charged density of states imaging in low dimensional structures using electrostatic force microscopy, In *Thermoelectric Materials-The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications: MRS Symposium Proceedings, Boston, volume 545*, edited by T. M. Tritt, H. B. Lyon, Jr., G. Mahan, and M. G. Kanatzidis, pages 345-350, Materials Research Society Press, Pittsburgh, PA, 1999.

continued

Faculty, Research Staff, and Publications

continued

- Z. Zhang, D. Gekhtman, M. S. Dresselhaus, and J. Y. Ying, Processing and Characterization of Single-Crystalline Ultrafine Bismuth Nanowires, *Chem. Mater.* 11, 1659 (1999).
- X. Sun, J. Liu, S. B. Cronin, K. L. Wang, G. Chen, T. Koga, and M. S. Dresselhaus. Experimental study of the effect of the quantum well structures on the thermoelectric figure of merit in the Si/Si_{1-x}Ge_x system, In *Thermoelectric Materials-The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications: MRS Symposium Proceedings, Boston, volume 545*, edited by T. M. Tritt, H. B. Lyon, Jr., G. Mahan, and M.G. Kanatzidis, pages 369-374, Materials Research Society Press, Pittsburgh, PA, 1999.
- D. Gekhtman, Z. B. Zhang, D. Adderton, M. S. Dresselhaus, and G. Dresselhaus, Electrostatic force spectroscopy and imaging of Bi wires: spatially resolved quantum confinement, *Phys. Rev. Lett.* 82, 3887 (1999).
- X. Sun, Z. Zhang, and M. S. Dresselhaus, Theoretical modeling of thermoelectricity in bismuth nanowires, *Appl. Phys. Lett.* 74, 4005-4007 (1999).
- S. Fleischer, H. J. Zeiger, M. S. Dresselhaus, E. Ippen, and G. Dresselhaus, Femtosecond Optical Studies of Intercalated Fullerenes, *Molecular Crystals and Liquid Crystals* (1999). Proceedings of ISIC-10.
- M. S. Dresselhaus, K. A. Williams, and P. C. Eklund, Hydrogen Adsorption in Carbon Materials, *MRS Bulletin* 24, 45-50 (1999). Submitted.
- J. Heremans, C. M. Thrush, Yu-Ming Lin, S. Cronin, Z. Zhang, M. S. Dresselhaus, and J. F. Mansfield, Bismuth nanowire arrays: synthesis and galvanomagnetic properties, *Phys. Rev. B* 61, 15 Jan (2000).
- G. Dresselhaus, M. A. Pimenta, R. Saito, J.-C. Charlier, S. D. M. Brown, P. Corio, A. Marucci, and M. S. Dresselhaus. On the overlap energy in carbon nanotubes, In *Science and Applications of Nanotubes*, edited by D. Tománek and R.J. Enbody, Kluwer Academic, New York, 1999. Proceedings of the International Workshop on the Science and Applications of Nanotubes, Michigan State University, East Lansing, MI, USA, July 24-27, 1999.
- M. S. Dresselhaus, M. A. Pimenta, K. Kneipp, S. D. M. Brown, P. Corio, A. Marucci, and G. Dresselhaus. First and Second-Order Resonant Raman Spectra of Single-walled Carbon Nanotubes, In *Science and Applications of Nanotubes*, edited by D. Tománek and R. J. Enbody, Kluwer Academic, New York, 1999. Proceedings of the International Workshop on the Science and Applications of Nanotubes, Michigan State University, East Lansing, MI, USA, July 24-27, 1999.
- K. Kneipp, H. Kneipp, P. Corio, S. D. M. Brown, K. Shafer, J. Motz, L. T. Perelman, E. B. Hanlon, A. Marucci, G. Dresselhaus, and M. S. Dresselhaus, Surface-enhanced and normal Stokes and anti-Stokes Raman spectroscopy of single-walled carbon nanotubes, *Phys. Rev. Lett.* page submitted (2000).
- C. Liu, Y. Y. Fan, M. Liu, H. T. Cong, H. M. Cheng, and M. S. Dresselhaus, Hydrogen storage in single-walled carbon nanotubes at room temperature, *Science* 286, 1127-1129 (1999).
- T. Koga, X. Sun, S. Cronin, and M. S. Dresselhaus. Carrier pocket engineering to design superior thermoelectric materials using superlattice structures, In *The 18th International Conference on Thermoelectrics: ICT Symposium Proceedings, Baltimore, Institute of Electrical and Electronics Engineers, Inc., Piscataway, NJ 09955-1331, 1999.*

continued

Faculty, Research Staff, and Publications

continued

P. Corio, S. D. M. Brown, A. Marucci, M. A. Pimenta, M. S. Dresselhaus, and K. Kneipp, Surface-Enhanced Resonant Raman of Single-Wall Carbon Nanotubes Adsorbed on Silver and Gold Island Films, (1999). Submitted PRB.

S. Cronin, Y.-M. Lin, T. Koga, X. Sun, J. Y. Ying, and M. S. Dresselhaus. Thermoelectric Investigation of Bismuth Nanowires, In The 18th International Conference on Thermoelectrics: ICT Symposium Proceedings, Baltimore, Institute of Electrical and Electronics Engineers, Inc., Piscataway, NJ 09955-1331, 1999.

X. Sun, S. B. Cronin, J. Lin, K. L. Wang, T. Koga, M. S. Dresselhaus, and G. Chen. Experimental Study of the Effect of the Quantum Well Structures on the Thermoelectric Figure of Merit in Si/Si_{1-x}Ge_x System, In The 18th International Conference on Thermoelectrics: ICT Symposium Proceedings, Baltimore, Institute of Electrical and Electronics Engineers, Inc., Piscataway, NJ 09955-1331, 1999.

M. S. Dresselhaus, Y. M. Lin, G. Dresselhaus, X. Sun, Z. Zhang, S. B. Cronin, T. Koga, and J. Y. Ying. Advances in 1D and 2D thermoelectric materials, In The 18th International Conference on Thermoelectrics: ICT Symposium Proceedings, Baltimore, Institute of Electrical and Electronics Engineers, Inc., Piscataway, NJ 09955-1331, 1999.

X. Sun, Y. M. Lin, S. B. Cronin, M. S. Dresselhaus, J. Y. Ying, and G. Chen. Theoretical Modeling of Thermoelectricity in Bi Nanowires, In The 18th International Conference on Thermoelectrics: ICT Symposium Proceedings, Baltimore, Institute of Electrical and Electronics Engineers, Inc., Piscataway, NJ 09955-1331, 1999.

A. M. Rao, A. Jorio, M. A. Pimenta, M. S. S. Dantas, R. Saito, G. Dresselhaus, and M. S. Dresselhaus, Polarized Raman Study of Aligned Multiwalled Carbon Nanotubes, Phys. Rev. Lett. page in press (2000).

M. S. Sander, Y.-M. Lin, M. S. Dresselhaus, and R. Gronsky. Structure and composition in bismuth nanowire arrays, In *Thermoelectric Materials-The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications: MRS Symposium Proceedings, Boston, December 1999*, edited by T. M. Tritt, H. B. Lyon, Jr., G. Mahan, and M. G. Kanatzidis, Materials Research Society Press, Pittsburgh, PA, 2000.

S. B. Cronin, Y.-M. Lin, T. Koga, J. Y. Ying, and M. S. Dresselhaus. Transport measurements of individual bismuth nanowires, In *Thermoelectric Materials-The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications: MRS Symposium Proceedings, Boston, December 1999*, edited by T. M. Tritt, H. B. Lyon, Jr., G. Mahan, and M. G. Kanatzidis, Materials Research Society Press, Pittsburgh, PA, 2000.

Y.-M. Lin, X. Sun, S. Cronin, Z. Zhang, J. Y. Ying, and M. S. Dresselhaus. Fabrication and transport properties of Te-doped bismuth nanowire arrays, In *Thermoelectric Materials-The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications: MRS Symposium Proceedings, Boston, December 1999*, edited by T. M. Tritt, H. B. Lyon, Jr., G. Mahan, and M. G. Kanatzidis, Materials Research Society Press, Pittsburgh, PA, 2000.

M. R. Black, Y.-M. Lin, M. S. Dresselhaus, M. Tachibana, S. Fang, O. Rabin, F. Ragot, P. C. Eklund, and Bruce Dunn. Measuring the dielectric properties of nanostructures using optical reflection and transmission: bismuth nanowires in porous alumina, In *Thermoelectric Materials-The Next Generation Materials for Small-Scale Refrigeration and Power Generation Applications: MRS Symposium Proceedings, Boston, December 1999*, edited by T. M. Tritt, H. B. Lyon, Jr., G. Mahan, and M. G. Kanatzidis, Materials Research Society Press, Pittsburgh, PA, 2000.

R. Saito, G. Dresselhaus, and M. S. Dresselhaus, Trigonal Warping Effect of Carbon Nanotubes, Phys. Rev. B 61, in press (2000).

continued

Faculty, Research Staff, and Publications

continued

Eugene A. Fitzgerald

Professor

Department of Materials Science and Engineering (DMSE)

Collaborators

M. Aziz, Harvard University
J. Borenstein, Draper Laboratories
G. Carey, Hewlett Packard Optoelectronics
S. Chua, National University of Singapore
J. Hsu, Lucent
S. Ringel, Ohio State University
S. Stockman, HP Optoelectronics
Y. Xie, UCLA

Graduate Students

Mathew Currie, Research Assistant, DMSE
Michael Groenert, DOD Fellow, DMSE
Andrew Kim, DOD Fellow, DMSE
Jessica Lai, Research Assistant, DMSE
Thomas Langdo, NSF Fellow, DMSE
Minjoo Lee, Research Assistant, DMSE
Christopher Leitz, DOD Fellow, DMSE
Lisa McGill, NSF Fellow, DMSE
Arthur Pitera, Research Assistant, DMSE
Gianni Taraschi, FCAR Canadian Fellow, DMSE
Vicky Yang, Research Assistant, DMSE

Undergraduate Students

Elissa Robbins

Publications

“Dislocations in Relaxed SiGe/Si Heterostructures”, E.A. Fitzgerald, M.T. Currie, S.B. Samavedam, T.A. Langdo, G. Taraschi, V. Yang, C.W. Leitz, and M.T. Bulsara, *Phys. Stat. Sol. (a)* 171, 227 (1999).

“Evolution of Microstructure and Dislocation Dynamics in $\text{In}_x\text{Ga}_{1-x}\text{P}$ Graded Buffers Grown on GaP by MOVPE: Engineering Device-Quality Substrate Materials”, A.Y. Kim W.S. McCullough, and E.A. Fitzgerald, *J. Vac. Sci. Tech. B* 17 (1999).

“Dislocation Dynamics in Relaxed Graded Composition Semiconductors”, E.A. Fitzgerald, A.Y. Kim, M.T. Currie, T.A. Langdo, G. Taraschi, and M.T. Bulsara, *Materials Science and Engineering B* 67, 53 (1999).

“Highly-Controlled GaAs/Ge Interfaces and Implications for III-V Optoelectronic Integration onto Group IV Substrates”, S.A. Ringel, J.A. Carlin, R.M. Sieg, J.J. Boeckl and E.A. Fitzgerald, *Lattice-Mismatched Thin Films* (TMS, Warrendale, PA) p. 87, (1999).

“Relaxed Graded Buffer Layers in the SiGe/Si and InGaAs/GaAs Materials Systems”, E.A. Fitzgerald, M.T. Bulsara, M.T. Currie, S.B. Samavedam, and T.A. Langdo, *Lattice-Mismatched Thin Films* (TMS, Warrendale, PA) p. 63, (1999).

“Monolithic Integration of III-V Materials and Devices on Si”, S.M. Ting, M.T. Bulsara, V. Yang, M. Groenert, S.B. Samavedam, M.T. Currie, T.A. Langdo, E.A. Fitzgerald, A. Joshi, R. Brown, X. Wang, R.M. Sieg, S.A. Ringel, *SPIE* 3630, 19 (1999).

“Engineering High-Quality InGaP Graded Composition Buffers on GaP for Transparent Substrate Light-Emitting Diodes”, A.Y. Kim and E.A. Fitzgerald, *SPIE* 3621, 179 (1999).

continued

Faculty, Research Staff, and Publications

continued

Clifton G. Fonstad, Jr.

Professor

Department of Electrical Engineering and Computer Science (EECS)

Research Staff, Affiliates, and Visitors

M. H. Madhusudhana Reddy, Visiting Scientist

Janez Megusar, Research Associate

P. Aitor Postigo, Post-Doctoral Fellow

Sheila Prasad, Northeastern U., Research Affiliate

Graduate Students

Joseph Ahadian, Research Assistant, EECS

Edward Barkley, Research Assistant, EECS

Henry Choy, Research Assistant, EECS

Wojciech Giziewicz, Research Assistant, EECS

Joanna London, GM Fellow, EECS

Michael Masaki, Research Assistant, EECS

Karen Young-Waithe, NSF and Draper Fellow, EECS

Undergraduate Students

Wojciech Giziewicz, UROP Student, EECS

Support Staff

Diane Hagopian, Administrative Assistant

Donna Gale, Senior Staff Assistant

Collaborators

John S. Ahearn, Sanders, LMCO, Nashua, NH

Robert DiMatteo, C. S. Draper Laboratory, Cambridge, MA

William Goodhue, U. Mass-Lowell, Lowell, MA

Andrew Loomis, MIT Lincoln Laboratory, Lexington, MA

James Mikkelsen, Vitesse Semiconductor,

Colorado Springs, CO

John Trezza, Sanders, LMCO, Nashua, NH

Publications

Hall, D. A., B. L. Shoop, J. R. Loy, E. K. Ressler, J. F. Ahadian, and C. G. Fonstad, Jr., "Performance of GaAs smart pixel components before and after monolithic integration of InGaP LEDs using Epitaxy-on-Electronics technology," *Optics Express*, Vol. 4 (1999) 151-160, <http://epubs.osa.org/opticsexpress/>.

London, J. M., A. H. Loomis, J. F. Ahadian, and C. G. Fonstad, Jr., "Preparation of silicon-on-gallium arsenide wafers for monolithic optoelectronic integration," *IEEE Photonics Tech. Lett.*, Vol. 11 (1999) 958-960.

Postigo, P. A., G. Lullo, K. H. Choy, and C. G. Fonstad, Jr., "Low temperature solid-source MBE growth of Al-free quantum well laser diodes using a GaP-decomposition source," *J. Vac. Sci. Technol. B*, Vol. 17 (1999) 1281-1284.

Knoedl, T., H. K. H. Choy, J. L. Pan, R. King, R. Jager, G. Lullo, J. F. Ahadian, R. J. Ram, C. G. Fonstad, Jr., and K. J. Ebling, "RCE photodetectors based on VCSEL structures," *IEEE Photonics Tech. Lett.*, Vol. 11 (1999) 1289-1291.

London, J. M., Pablo A. Postigo, and C. G. Fonstad, Jr., "Quantum well heterostructures grown by molecular beam epitaxy on silicon-on-gallium arsenide substrates," *J. Appl. Phys.*, Vol. 75 (1999) 3452-3454.

Pan, J. L., and C. G. Fonstad, Jr., "Physical model of depletion and accumulation in quantum well infrared photodetectors," *IEEE J. Quantum Electronics*, Vol. 35 (1999) 1673-1684.

Maj, T., A. Kirk, D. Plant, J. Ahadian, C. Fontad, K. Lear, K. Tatah, R. Robinson, and J. A. Trezza, "Interconnection of a two-dimensional VCSEL array to a receiver array via a fiber image guide," *Applied Optics*, Vol. 39 (2000), to be published.

Pan, J. L., and C. G. Fonstad, Jr., "The hole intersubband absorption strength in quantum well infrared photodetectors," submitted for publication.

Pan, J. L., C. G. Fonstad, Jr., and K. Matney, "Measurement of layer width uniformity in quantum well infrared photodetectors by high resolution X-ray techniques," submitted for publication.

continued

Faculty, Research Staff, and Publications

continued

Karen K. Gleason

Associate Professor

Department of Chemical Engineering (ChE)

Graduate Students

D. D. Burkey, Research Assistant, ChE
B. A. Cruden, Research Assistant, ChE
K. K. S. Lau, Research Assistant, ChE
C. B. Labelle, Research Assistant, ChE
H. M. Lei, Research Assistant, ChE
L.S. Loo, Research Assistant, ChE
S. K. Murthy, Research Assistant, ChE
H. Pryce-Lewis, Research Assistant, ChE

Research Staff

E. J. Winder
P. Y. Mabboux

Publications

K.K.S. Lau and K.K. Gleason, "Solid-State NMR of Low Dielectric Constant Films from Pulsed Hydrofluorocarbon Plasmas", *J. Electrochem. Soc.*, **146**, 2652 (1999).

C.B. Labelle and K.K. Gleason, "Pulsed Plasma Enhanced Chemical Vapor Deposition from CH_2F_2 , $\text{C}_2\text{H}_2\text{F}_4$, and CHClF_2 ", *J. Vac. Sci. Technol. A*, **17**, 445 (1999).

S.J. Limb, D.J. Edell, E.F. Gleason and K.K. Gleason, "Comparison of Pulsed Plasma Enhanced Chemical Vapor Deposition and Pyrolytic Chemical Vapor Deposition from Hexafluoropropylene Oxide", *Plasmas and Polymers* **4(1)**, 21 (1999).

I. Banerjee, M. Harker, L. Wong, P.A. Coon and K.K. Gleason, "Characterization of CVD Deposited Amorphous Fluorocarbons for Low k Interlayer Dielectrics", *J. Electrochem. Soc.*, **146**, 2219 (1999).

C.B. Labelle, S.M. Karecki, L.R. Reif and K.K. Gleason, "Fourier Transform Infrared Spectroscopy of Effluents from Pulsed Plasmas of 1,1,2,2-Tetrafluoroethane, Hexafluoropropylene, and Difluoromethane", *J. Vac. Sci. Technol. A*, **76**, 3419 (1999).

L.S. Loo, R.E. Cohen and K.K. Gleason, "Deuterium Nuclear Magnetic Resonance of phenol-d5 in Nylon 6 under Active Uniaxial Deformation", *Macromolecules*, **32**, 4359 (1999).

C.B. Labelle and K.K. Gleason, "Surface Morphology of PECVD Fluorocarbon Thin Films from Hexafluoropropylene Oxide, 1,1,2,2-Tetrafluoroethane and Difluoromethane", *J. Appl. Polym. Sci.*, **74**, 2439-2447 (1999).

C.B. Labelle and K. K. Gleason, "Overhang Test Structure Deposition Profiles of Pulsed Plasma Fluorocarbon Films from Hexafluoropropylene Oxide, 1,1,2,2-Tetrafluoroethane and Difluoromethane", *Adv. Materials:Chem. Vap. Dep.*, **6**, 27 (2000).

K. K. Gleason, "History and Future of Fluorocarbon CVD Low k Dielectric Thin Films", *Proc. 5th International Dielectrics for ULSI Metalization Interconnection Conference (DUMIC)*, **11** (1999).

B. Cruden, K. Chu, K. Gleason, and H. Sawin, "Thermal Decomposition of Low-k Pulsed Plasma Fluorocarbon Films. I. Effects of Precursors and Substrate Temperature", *J. Electrochem. Soc.* **146**, 4590 (1999).

B. Cruden, K. Chu, K. Gleason, and H. Sawin, "Thermal Decomposition of Low-k Pulsed Plasma Fluorocarbon Films. II. Effect of Post-Deposition Annealing and Ambients", *J. Electrochem. Soc.* **146**, 4597 (1999).

continued

Faculty, Research Staff, and Publications

continued

N. W. Hagood

Associate Professor

Department of Aeronautics and Astronautics

Research Staff

M. J. Atalla, Research Associate, Aero/Astro

H. Li, Postdoctoral Associate, Aero/Astro

L. Saggere, Research Associate, Aero/Astro

Yu-Hsuan Su, Postdoctoral Associate, Aero/Astro

Collaborators

Kenny Breuer, Assoc. Prof., Brown U.

C. E. S. Cesnik, Assist. Prof., Aero/Astro

Y.-M. Chiang, Professor, MSE

M. J. Cima, Professor, MSE

R. Mlcak, Boston Micro Systems Inc.

M. Schmidt, Prof., EECS

M. Spearing, Assoc. Prof., Aero/Astro

H. R. Steven, Assoc. Prof., Aero/Astro

Graduate Students

C. T. Dunn, MS Candidate, Aero/Astro

M. Fripp, Ph.D. Candidate, Aero/Astro

T. Glenn, Ph.D. Candidate, Aero/Astro

J. Harper, MS Candidate, Aero/Astro

B. Janos, Ph.D. Candidate, MSE

C.-Y. Lin, Ph.D. Candidate, Aero/Astro

P. Lively, MS Candidate, Aero/Astro

D. C. Roberts, Ph.D. Candidate, Mech E.

M. Schimdt, MS Candidate, Mech E.

Y. Shi, MS Candidate, Aero/Astro

K. Song, Ph.D. Candidate, Aero/Astro

L. Steyn, MS Candidate, Aero/Astro

K. Turner, MS Candidate, Aero/Astro

M. Tupper, MS Candidate, Aero/Astro

V. Wickramasinghe, MS Candidate, Aero/Astro

O. Yaglioglu, MS Candidate, Aero/Astro

Publications

Bingham, B.S., Hagood, N.W., Atalla, M.J. "Performance Comparison of Feedback and Feedforward Structural-Acoustic Control Techniques" SPIE Smart Structures and Materials Conference, Newport Beach, CA, March 1999.

Lutz, M.K., Hagood, N.W., "Actuation Efficiency in

Piezoelectricly Driven linear and Non-linear Systems", SPIE Smart Structures and Materials Conference, Newport Beach, CA, March 1999.

Lutz, M.K., and N.W. Hagood, "Power Flow and Work Efficiency in Nonlinear Piezoelectric Systems," Smart Structures and Materials 1999: Smart Structures and Integrated Systems, Newport Beach, CA, March 1999.

Janos, B.Z., Hagood, N.W., "Magnetic Particle Doping for Anisotropic Matrix Materials in Active Fiber Composites" SPIE Smart Structures and Materials Conference, Newport Beach, CA, March 1999.

Morris, D.G., A. Pizzochero, and N.W. Hagood, "Experimental Investigation on the Effect of Environmental Stress on Active Fiber Composite Actuators," Smart Structures and Materials 1999: Smart Structures and Integrated Systems, Newport Beach, CA, March 1999.

Chiang, Y.-M., G.W. Farrey, A. Soukhojak, S. Sheets, G. Maskaly, H. Wang, and N.W. Hagood, "Growth and Characterization of Alkaline Bismuth Titanate Single Crystals and Single Crystal Fibers," U.S. Navy Workshop on Acoustic Transduction Materials and Devices, Blacksburg, VA, April 1999.

Bingham, B.S., N.W. Hagood, Atalla, M.J. "Experimental Comparison of Structural-Acoustic Control Designs on an Integrally Actuated Composite Panel"

N. W. Hagood et al., "Smart Structure Applications Using PZT Fibres and Patches at MIT", Euromat, Sept. 27, 1999, Munich, Germany

N. W. Hagood et al., "Development of Micro Hydraulic Transducer Technology" 10th International Conference on Adaptive Structures and Technologies (ICAST) Oct 11-13, 1999,

continued

Faculty, Research Staff, and Publications

continued

Hermann A. Haus
Institute Professor
Department of Electrical Engineering
and Computer Science (EECS)

N. W. Hagood et al., "Reconfigurable Arrays for Broadband Feedback Control of Aircraft Fuselage Vibration," 10th International Conference on Adaptive Structures and Technologies (ICAST), Oct 11-13, 1999, Paris, France.

Fripp, M.L., M.J. Atalla, N.W. Hagood, C. Savran, and S. Tistaert. "Reconfigurable Arrays for Broadband Feedback Control of Aircraft Vibrations" ICAST - International Conference on Active Structures Technology, Paris, France, October, 1999.

Graduate Students

J. M. Kahn, EECS
C. Manolatu, EECS

Support Staff

C. Kopf, Secretary
M. Aldridge, Secretary

Publications

C. Manolatu, M. J. Khan, S. Fan, P. R. Villeneuve, H. A. Haus, J. D. Joannopoulos, "Coupling of modes analysis of resonant channel add/drop filters", IEEE J. Quantum Electron., vol.35, no.9, pp 1322-1331, Sept. 1999.

M. J. Khan, C. Manolatu, S. Fan, P. R. Villeneuve, H. A. Haus, J. D. Joannopoulos, "Mode Coupling Analysis of Multipole Symmetric Resonant Add/Drop Filters", IEEE J. Quantum Electron., vol.35, no.10, pp 1451-1460, Oct. 1999.

C. Manolatu, S. G. Johnson, S. Fan, P. R. Villeneuve, H. A. Haus, J. D. Joannopoulos, "High-Density Integrated Optics", J. Lightwave Technol., vol.17, no.9, pp. 1682 - 1692, Sept. 1999.

S.G. Johnson, C. Manolatu, S. Fan, P.R. Villeneuve, J.D. Joannopoulos, H. A. Haus, "Elimination of crosstalk in waveguide intersections", Optics. Lett., vol.23, no.23, pp. 1855-1857, Dec. 1998.

H.A. Haus, "Photonic Nanostructures and Resonators", (invited paper), Integrated Photonics Research, Santa Barbara, CA, 1999.

continued

Faculty, Research Staff, and Publications

continued

Judy L. Hoyt

Associate Professor

Department of Electrical Engineering and Computer Science (EECS)

Collaborators

Dimitri Antoniadis, Prof., EECS

Jesus del Alamo, Prof., EECS

Eugene Fitzgerald, Assoc. Prof., Mat. Sci.

Charles Fortmann, Assoc. Prof., Stonybrook

James Gibbons, Prof. EE, Stanford Univ.

Piero Pianetta, Prof. EE, Stanford Univ.

K. Rim, J. L. Hoyt, J. F. Gibbons, "Transconductance Enhancement in Deep Submicron Strained-Si *n*-MOS-FETs," in *IEEE IEDM Tech Dig.*, 707-710, (Dec. 1998).

Graduate Students

Brian Greene, Applied Physics, Stanford Univ.

Dinkar Singh, Applied Physics, Stanford Univ.

Steven Hung, EE, Stanford Univ.

Visiting Scientists

Satoshi Eguchi, Hitachi (MIT, Sept., 2000)

Publications

D.V. Singh, T.O. Mitchell, J.L. Hoyt, J.F. Gibbons, N.M. Johnson, and W.K. Gotz, "Effect of grown-in biaxial strain on deep level defects in $\text{Si}_{1-y}\text{C}_y$ /Si epitaxial heterostructures," *Physica B*, Vol. 273-274, 681-684 (1999).

J.L. Hoyt, K. Rim, and J.F. Gibbons, "Performance Enhancements in Strained Si/Relaxed SiGe MOSFETs", Proceedings of the International Joint Conference on Si Epitaxy and Heterostructures, Zao, Mayagi, Japan, p. I-4, September, 1999).

D.V. Singh, K. Rim, T.O. Mitchell, J.L. Hoyt and J.F. Gibbons, "Measurement of the Conduction of Band Offsets in Si/SiGeC and Si/Si_{1-y}C_y Heterostructures using Metal-Oxide-Semiconductor Capacitors," *J. Appl. Phys.* **85** (2), 978-984, (Jan 1999).

continued

Faculty, Research Staff, and Publications

continued

Qing Hu

Professor

Department of Electrical Engineering and Computer Science (EECS)

Publications

Zamdmer, Q. Hu, S. Verghese, and A. Förster, "Mode-discriminating photoconductor and coplanar waveguide circuit for picosecond sampling," *Appl. Phys. Lett.* **74**, 1039 (1999).

Hu, Q. and I. Lyubomirsky, "Response to 'Comment on Energy level schemes for far-infrared quantum-well lasers,'" *Appl. Phys. Lett.* **74**, 3065 (1999).

de Lange, G., K. Konistis, and Q. Hu, "A 3x3 millimeter-wave micromachined imaging array with superconductor-insulator-superconductor mixers," *Appl. Phys. Lett.* **75**, 868 (1999).

Zamdmer, N., Q. Hu, K. A. McIntosh, and S. Verghese, "Increase in response time of low-temperature-grown GaAs photoconductive switches at high voltage bias," *Appl. Phys. Lett.* **75**, 2313 (1999).

Williams, B. S., B. Xu, Q. Hu, and M. R. Melloch, "Narrow-linewidth Terahertz Intersubband Emission from Three-level Systems," *Appl. Phys. Lett.* **75**, 2927 (1999).

Zamdmer, N., Q. Hu, K. A. McIntosh, and S. Verghese, "On-chip frequency-domain submillimeter-wave transceiver," *Appl. Phys. Lett.* **75**, 3877 (1999).

Conference Presentations

Zamdmer, N., Q. Hu, K. A. McIntosh, and S. Verghese, "Theoretical and Experimental Study of a Low-temperature-grown GaAs Photoconductive Switch Under High Voltage Bias," presented at Ultrafast Electronics and Optoelectronics, Snowmass, Colorado, April 16 (1999).

B. S. Williams, B. Xu, Q. Hu, and M. R. Melloch, "Narrow linewidth terahertz intersubband emission from three-level multiple quantum well structures," presented at the 5th International Conference on Intersubband Transitions in Quantum Wells (ITQW'99), Bad Ischl, Austria, September (1999).

B. S. Williams, B. Xu, Q. Hu, and M. R. Melloch, "Narrow-Linewidth Terahertz Intersubband Emission from Three Level Systems," presented at 1999 Material Research Society Fall Meeting, Boston, MA, November 30 (1999). (invited)

continued

Faculty, Research Staff, and Publications

continued

Lionel C. Kimerling

Thomas Lord Professor of Materials Science

Department of Materials Science and Engineering (DMSE)

Director

Materials Processing Center (MPC)

Research Staff

J. Michel, Research Associate, MPC

A. Agarwal, Research Associate, MPC

X. Duan, Research Associate, MPC

J. Yu, Visiting Scientist, MPC

K. Wada, Visiting Senior Lecturer

M. Lipson, Post-Doctoral Associate, MPC

P. Kopperschmidt, Post Doctoral Associate, MPC

N. Toyoda, Post Doctoral Associate, MPC

K. Kono, Visiting Scientist, MPC

Collaborators

L. Allen, IBIS

J. Benton, Lucent Technologies

L. Beu, Motorola

C. Chidsey, Stanford U.

D. Eaglesham, Lucent Technologies

C. Fine, MIT

E. Fitzgerald, MIT

H. Fujimoto, Intel

G. Gilmer, Lucent Technologies

Hermann Haus, MIT

G. Higashi, Lucent Technologies

E. Ippen, MIT

J. Joannopoulos, MIT

T. Kamins, Hewlett Packard

L. Kolodziejski, MIT

D. Miller, Stanford U.

H. Okorn-Schmidt, IBM

B. Parekh, Millipore

R. Parker, Hewlett Packard

J. Rosamilia, Lucent Technologies

W. Rees, Georgia Tech

R. Reif, MIT

M. Schmidt, MIT

J.-H. Shyu, Millipore

D. Sinclair, Lucent Technologies

A. White, Lucent Technologies

Graduate Students

S.H. Ahn, Research Assistant, MSE

T. Burr, Research Assistant, MSE

D. Cannon, Rosenblith Fellow, MSE

J. Chan, Research Assistant, MSE/TPP

K. Chen, DoD Fellow, MSE

T. Chen, Research Assistant, MSE

T. Cortesi, LFM Fellow

J. Kang, LFM Fellow, MSE

K. Lee, Research Assistant, MSE

D. Lim, Research Assistant, EECS

A. Luan, Research Assistant, MSE

E. Ouellette, Research Assistant, EECS

V. Phanse, LFM Fellow, MSE

A.Reddy, Research Assistant, MSE

S. Saini, Research Assistant, MSE

J. Sandland, Research Assistant, MSE

A. Smith, DoE Fellow, MSE

Undergraduate Students

J. Cagas, MSE

S. Jung, MSE

G. Martinez Castillo, MSE

T. Montalbo, MSE

A.Soloman, MSE

A.Sparks, MSE

Publications

A. Agarwal, J.S. Foresi, L.M. Giovane, L. Liao, J. Michel, K. Wada, and L.C. Kimerling, "Defect Engineering for Si Microphotonics", Defects in Silicon: Proceedings of the 3rd International Symposium. ECS, (99) 215 (1999).

H.S. Luan, K. Wada, L.C. Kimerling, G. Masini, L. Colace, G. Assanto, "High responsivity near infrared Ge photo-detectors integrated on Si" *Electronics Letters*, 17 (35) 1467 (1999).

continued

Faculty, Research Staff, and Publications

continued

T.D.Chen, M. Platero, M. Opher-Lipson, J. Palm, J. Michel, L.C. Kimerling. "The Temperature Dependence of Radiative and Nonradiative Processes at Er-O Centers in Si" *Physica B*, (Jan 2000).

K. Wada, L.C. Kimerling, "Si-LSIs and microphotronics" *Oyo Buturi* 68 (9) 1034 (1999).

K. Wada, T. Chen, J. Michel, L.C. Kimerling, H. Aga, K. Mitani, T. Abe. Suezawa, "Photonic band gap by wafer bonding and delamination" *MRS Proceedings*. 535 (1998).

Kimerling, L.C. "Silicon Materials for the Next Millennium" *Proceedings of the 8th International Autumn Meeting: Gettering and Defect Engineering in Semiconductor Technology*, eds. H.G. Grimmeiss, et al, (Zurich: Scitec Publications, 1999), p.131.

Kimerling, L.C. "Devices for Si Microphotonic Interconnection: Photonic Crystals, Waveguides and Si Optoelectronics" *57th Annual Device Research Conference Digest*, IEEE, New York 108 (1999).

H.C. Luan, D.R. Lim, K.K. Lee, K.M. Chen, J.G. Sandland, K. Wada, L.C. Kimerling, "High quality Ge epilayers on Si with low threading-dislocation densities" *Applied Physics Letters*, 75 (19) 2909 (1999).

L.C. Kimerling, "Silicon Microphotronics", Proceedings for the ISCSI-III Conference, Japan, October (1999).

K.M. Chen, A.W. Sparks, H.-C. Luan, K. Wada, L.C. Kimerling, "SiO₂/TiO₂ omnidirectional reflector and microcavity resonator via the sol-gel method" *Applied Physics Letters*, 75 (24) 3805 (1999).

J. Michel, L.C. Kimerling, V.V. Emtsev, V.V. Emstev, Jr., D.S. Poloskin, E.I. Shek, N.A. Sobolev, "Oxygen and erbium related donor centers in Czochralski grown silicon implanted with erbium" *Semiconductors*, 33 (10) 1084 (1999).

H.C. Luan, D.R. Lim, L. Colace, G. Masini, G. Assanto, K. Wada, L.C. Kimerling, "Germanium photodetectors for silicon microphotronics by direct epitaxy on silicon" *Materials Research Society Symposium Proceedings Series*, 607 (2000).

A.L. Smith, S.T. Dunham, L.C. Kimerling, "Transition metal defect behavior and Si Density of States in the processing temperature regime" *ICDS-20, Berkeley, 1999 Physica B* 273-274, 358 (1999).

A.J. Reddy, J.V. Chan, T.A. Burr, R. Mo, C.P. Wade, C.E.D. Chidsey, J. Michel, L.C. Kimerling, "Defect states at silicon surfaces" *ICDS-20, Berkeley, 1999 Physica B* 273-274 468 (1999).

T.D. Chen, M. Platero, M. Opher-Lipson, J. Palm, J. Michel, L.C. Kimerling, "The temperature dependence of radiative and nonradiative processes at Er-O centers in Si" *ICDS-20, Berkeley Physica B* 273-274 322 (1999).

continued

Faculty, Research Staff, and Publications

continued

Leslie A. Kolodziejski

Professor

Department of Electrical Engineering and Computer Science (EECS)

Research Staff

G. S. Petrich, Research Scientist, EECS and RLE

Graduate Students

A. A. Erchak, Research Assistant, DMSE

E. M. Koontz, Research Assistant, EECS

A. Markina, Research Assistant, EECS

S. C. Warnick, Research Assistant, EECS

Undergraduate Students

S. Assefa, EECS

Support Staff

D. W. Hagopian, Administrative Assistant, EECS

D. L. Gale, Secretary, EECS

Publications

E. M. Koontz, G. D. U'Ren, M. H. Lim, L. A. Kolodziejski, M. S. Goorsky, G. S. Petrich, and Henry I. Smith, "Overgrowth of (In,Ga)(As,P) on Rectangular-Patterned Surfaces Using Gas Source Molecular Beam Epitaxy." *J. Cryst. Growth*, 198/199, 1104-1110 (1999).

E. M. Koontz, G. S. Petrich, L. A. Kolodziejski, and M. S. Goorsky, "Overgrowth of Submicron-Patterned Surfaces for Buried Index Contrast Devices." Forthcoming in *Semiconductor Science and Technology*, (2000).

P. Langlois, M. Joschko, E. R. Thoen, E. M. Koontz, F. X. Kartner, E. P. Ippen, and L. A. Kolodziejski, "High Fluence Ultrafast Dynamics of Semiconductor Saturable Absorber Mirrors." *Appl. Phys. Lett.*, 75(24), 3841-3843 (1999).

E. R. Thoen, E. M. Koontz, M. Joschko, P. Langlois, T. R. Schibli, F. X. Kartner, E. P. Ippen, and L. A. Kolodziejski, "Two-Photon Absorption in Semiconductor Saturable Absorber Mirrors." *Appl. Phys. Lett.*, 74(26), 3927-3929 (1999).

E. R. Thoen, E. M. Koontz, D. J. Jones, D. Barbier, F. X. Kartner, E. P. Ippen, and L. A. Kolodziejski, "Erbium-Ytterbium Waveguide Laser Mode-locked with a Semiconductor Saturable Absorber Mirror." Forthcoming in *IEEE Photon. Technol. Lett.*, (2000).

M. Joschko, P. Langlois, E. R. Thoen, E. M. Koontz, E. P. Ippen, and L. A. Kolodziejski, "Ultrafast Hot-Carrier dynamics in Semiconductor Saturable Absorber Mirrors." Forthcoming in *Appl. Phys. Lett.*, (2000).

Steven G. Johnson, Shanhui Fan, Pierre R. Villeneuve, J. D. Joannopoulos, and L. A. Kolodziejski, "Guided Modes in Photonic Crystal Slabs." *Phys. Rev. B.*, 60(8), 5751-5758 (1999).

D. J. Ripin, Kuo-Yi Lim, G. S. Petrich, Pierre R. Villeneuve, Shanhui Fan, E. R. Thoen, J. D. Joannopoulos, E. P. Ippen, and L. A. Kolodziejski, "One-Dimensional Photonic Bandgap Microcavities for Strong Optical Confinement in GaAs and GaAs/Al_xO_y Semiconductor Waveguides." *IEEE J. Light. Tech.*, 17(11), 2152-2160 (1999).

K.-Y. Lim, D. J. Ripin, G. S. Petrich, L. A. Kolodziejski, E. P. Ippen, M. Mondol, H. I. Smith, P. R. Villeneuve, S. Fan and J. D. Joannopoulos, "Photonic Bandgap Waveguide Microcavities: Monorails and Airbridges." *J. Vac. Sci. Tech. B*, 17(3), 1171-1174 (1999).

K.-Y. Lim, D. J. Ripin, G. S. Petrich, P. R. Villeneuve, S. Fan, J. D. Joannopoulos, E. P. Ippen, and L. A. Kolodziejski, "The role of the thermal oxide in GaAs-based photonic bandgap waveguide microcavities." *Adv. Mater.*, 11(6), 501-505 (1999).

S. G. Patterson, G. S. Petrich, R. J. Ram, L. A. Kolodziejski, "X-ray Diffraction Analysis of Bandgap-Engineered Distributed Bragg Reflectors" *J. Electron. Mater.*, 28(10), 1081-1083 (1999).

S. G. Patterson, G. S. Petrich, R. J. Ram, L. A. Kolodziejski, "Continuous-wave Room Temperature Operation of Bipolar Cascade Laser." *Elect. Lett.* 35(5), 395-397 (1999).

continued

Faculty, Research Staff, and Publications

continued

Jeffrey H. Lang

Professor

Department of Electrical Engineering and Computer Science (EECS)

Research Staff

Carol Livermore, Postdoctoral Associate, MTL

Collaborators

M. G. Allen, Professor, ECE, GA Institute of Technology

A. P. Chandrakasan, Associate Professor, EECS

A. H. Epstein, Professor, AA

T. M. Jahns, Professor, ECE, University of Wisconsin

T. A. Keim, Principal Research Engineer, LEES

J. L. Kirtley, Jr, Professor, EECS

M. A. Schmidt, Professor, EECS

S. D. Senturia, Professor, EECS

A. H. Slocum, Professor, ME

S. D. Umans, Principal Research Engineer, EECS

M. Tolikas, J. H. Lang and J. L. Kirtley; "Algebraic dual energy magnetic analysis with application to variable reluctance motor design"; IEEE Transactions on Power Apparatus and Systems, 14, 270-276, September 1999.

E. C. Lovelace, T. M. Jahns and J. H. Lang; "Impact of saturation and inverter cost on interior permanent-magnet synchronous machine drive optimization"; Proceedings: IEEE International Electric Machines and Drives Conference, 125-131, Phoenix, AZ, October 3-7, 1999.

J. E. Wong, J. H. Lang and M. A. Schmidt; "An electrostatically actuated MEMS switch for power applications"; Proceedings: IEEE Workshop on Micro Electro Mechanical Systems, Miyazaki, Japan, January 23-27, 2000.

Graduate Students

H. Koser, Research Assistant, EECS

L. M. Lorilla, Research Assistant, EECS

E. C. F. Lovelace, Research Assistant, EECS

J. O. Mur-Miranda, NSF Fellow, EECS

S. F. Nagle, Research Assistant, EECS

J. Qiu, Research Assistant, ME

J. E. Wong, Research Assistant, ME

Publications

E. C. Lovelace, T. M. Jahns and J. H. Lang; "A saturating lumped parameter design model for an interior permanent magnet synchronous motor"; Proceedings: IEEE International Electric Machines and Drives Conference, 553-555, Seattle, WA, May 9-12, 1999.

S. F. Nagle and J. H. Lang; "A micro-scale electric-induction machine for a micro gas turbine generator"; Proceedings: Conference of the Electrostatics Society of America, 57-66, Boston, MA, June 23-25, 1999.

S. Meninger, J. O. Mur-Miranda, R. Amirtharajah, A. P. Chandrakasan and J. H. Lang; "Vibration-to-electric energy conversion"; Proceedings: International Symposium on Low Power Electronics and Design, 48-53, San Diego, CA, August 16-17, 1999.

continued

Faculty, Research Staff, and Publications

continued

Hae-Seung Lee

Professor

*Department of Electrical Engineering
and Computer Science (EECS)*

Dr. Ichiro Masaki

Principal Research Associate

Microsystems Technologies Laboratories

Graduate Students

John Bulzacchelli, EECS

Michael Guidry, EECS

Kush Gulati, Research Assistant, EECS

Susanne Paul, Research Assistant, EECS

Mark Peng, Research Assistant, EECS

Aiman Shabra, Research Assistant, EECS

Mark Spaeth, Research Assistant, EECS

Susan Dacy, EECS

Visiting Scientists

T. Kato, Toyota Central R&D

I. Mizunuma, Mitsubishi Electric

Collaborators

Dr. Masaki leads the Intelligent Transportation Research Center at MIT's Microsystems Technology Laboratories. Through the center, he is collaborating with the following faculty members and their students:

B. K. P. Horn, EECS

H.-S. Lee, EECS

T. B. Sheridan, Mechanical

C. G. Sodini, EECS

J. M. Sussman, Civil and Environmental

J. L. Wyatt, EECS

Publications

S. Paul, H.-S. Lee, J. Goodrich, T. Alailima, and D. Santiago, "A Nyquist-rate Pipelined Oversampled A/D Converter," Digest of Technical Papers, 1999 International Solid-State Circuits Conference, pp. 54-55, Feb. 1999, San Francisco, CA

J.F. Bulzacchelli, H.-S. Lee, J.A. Misewich, and M.B. Ketchen, "Superconducting Bandpass Delta-Sigma A/D Converter," International Superconductive Electronics Conference, June 21-25, 1999, Berkeley, CA

S. Paul, H.-S. Lee, J. Goodrich, T. Alailima, and D. Santiago, "A Nyquist-rate Pipelined Oversampled A/D Converter," IEEE J. Solid-State Circuits, Dec. 1999

Graduate Students

(in collaboration with Prof. B. K. P. Horn)

Y. Fang, Research Assistant, EECS

N. S. Love, Research Assistant, EECS

Publications

Masaki, "Intelligent Transportation Systems", Journal of Institute of Industrial Science, University of Tokyo, Vol.51, No.7, pp.18-21 (July 1999)

I.Masaki, "Intelligent Transportation Systems for the 21st Century", Technical Journal of Mitsubishi Electronics, Vol.73, No.10, pp.687 (October 1999)

continued

Faculty, Research Staff, and Publications

continued

Michael B. McIlrath
Research Scientist
Department of Electrical Engineering
and Computer Science (EECS)

I.Masaki, "Intelligent Transportation Systems", Seminar in Electronic Show, Makuhari, Japan (October 1999)

I.Masaki, "Communication Systems for Intelligent Transportation Systems", Design Conference, Nikkei Electronics, Yokohama, Japan (May 1999)

Z.K. Lee, M.B. McIlrath, and D.A. Antoniadis, "Two-dimensional Doping Profile Characterization of MOSFETs by Inverse Modeling Using I-V Characteristics in the Subthreshold Region" IEEE Trans. Electron Devices, Vol. 46. No. 8, 1640-1649 (August 1999).

D.E. Troxel, D.S. Boning, and M.B. McIlrath, "Semiconductor Process Representation", in Encyclopedia of Electrical and Electronics Engineering, vol. 19, 139-147. J. Wiley and Sons, NY (1999).

continued

Faculty, Research Staff, and Publications

continued

Terry P. Orlando

Professor

Department of Electrical Engineering and Computer Science (EECS)

Research Staff

Dr. Juan Mazo, Visiting Scientist, EECS

J.J. Mazo, E. Trías, T.P. Orlando, "Discrete breathers in dc biased Josephson-junction arrays," *Phys. Rev. B* 59: 13604-13607 (1999).

Graduate Students

D.S. Crankshaw, Research Assistant, EECS

A.E. Duwel, Research Assistant, EECS

D. Nakada, Research Assistant, EECS

L. Tian, Research Assistant, Physics

E. Trías, Research Assistant, EECS

E. Trias, J.J. Mazo, F. Falo, T.P. Orlando, "Depinning of kinks in a Josephson-junction ratchet array," *Phys. Rev. E*, **61**, 2257-266 (2000).

Visiting Student

A. Brinkman, Twente University

Support Staff

D.W. Hagopian, Administrative Assistant, EECS

Publications

J.E. Mooij, T.P. Orlando, L. Tian, C.H. van der Wal, L. Levitov, S. Lloyd, and J.J. Mazo, "A superconducting persistent current qubit," *Science* 285: 1036-1039 (1999).

T.P. Orlando, J.E. Mooij, L. Levitov, L. Tian, C.H. van der Wal, S. Lloyd, and J.J. Mazo, "Josephson persistent current qubit," *Phys. Rev. B* 60: 15398-15413 (1999).

L. Tian, L. Levitov, C.H. van der Wal, J.E. Mooij, T.P. Orlando, S. Lloyd, C.J.P.M. Harmans, J.J. Mazo, "Decoherence of the superconducting persistent current qubit," to be published in the Nato Summer School in the proceedings of the NATO-ASI on "Quantum Mesoscopic Phenomena and Mesoscopic Devices in Microelectronics," in June 13-27, 1999, in Ankara, Turkey, and it is on line in the Lanl preprint server as: <http://xxx.lanl.gov/cond-mat/9910062>.

E. Trias, J.J. Mazo, T.P. Orlando, "Discrete breathers in nonlinear lattices: Experimental detection in a Josephson array," *Phys. Rev. Letts.*, **84**, 741-744, (2000).

continued

Faculty, Research Staff, and Publications

continued

Rafael Reif

Professor and Associate Department Head

Department of Electrical Engineering and Computer Science (EECS)

Graduate Students

R. Chatterjee, Research Assistant (EECS)

A. Fan, Research Assistant (EECS)

S. Karecki, Research Assistant (EECS)

W. Mao, Research Assistant (MSE)

L. Pruette, Research Assistant (EECS)

M. Qi, Research Assistant (EECS)

A. Rahman, Research Assistant (EECS)

Support Staff

P. Varley, Administrative Assistant, MTL

I. Smith, Administrative Assistant, EECS

Publications

Arifur Rhaman, Andy Fan, and Rafael Reif, "Wire-length distribution of three-dimensional integrated circuits", Presented at the 1999 Workshop on System-Level Interconnect Prediction (SLIP), April 10-11, Monterey, CA.

Arifur Rhaman, Andy Fan, and Rafael Reif, "Wire-length distribution of three-dimensional integrated circuits", Presented at the 1999 International Interconnect Technology Conference (IITC), May 24-26, San Francisco, CA.

Andy Fan, Arifur Rahman, and Rafael Reif, "Copper Wafer Bonding", *Electrochemical and Solid-State Letters*, pp 534-536, vol. 2(10), 1999.

S. Karecki, R. Chatterjee, L. Pruette, R. Reif, T. Sparks, L. Beu, and V. Vartanian, "Evaluation of Pentafluoroethane and 1,1-Difluoroethane for a Dielectric Etch Application in an Inductively Coupled Plasma Etch Tool," submitted to *Jpn. J. Appl. Phys.*, 1999.

L. Pruette, S. Karecki, R. Reif, L. Tousignant, W. Reagan, S. Kesari, L. Zazzera, "Evaluation of C_4F_8O as an Alternative Plasma Enhanced Chemical Vapor Deposition Chamber Clean Chemistry," submitted to *J. Electrochem. Soc.*, 1999.

C. B. Labelle, S. M. Karecki, R. Reif, and K. K. Gleason, "Fourier Transform Infrared Spectroscopy of Effluents from Pulsed Plasmas of 1,1,2,2-Tetrafluoroethane, Hexafluoropropylene Oxide, and Difluoromethane," *J. Vac. Sci. Technology A* **17(6)**, 3419-3428, November/December 1999.

L. Pruette, S. Karecki, R. Reif, W. Entley, J. Langan, V. Hazari, C. Hines, "Evaluation of a Dilute Nitrogen Trifluoride Plasma Clean in a Dielectric PECVD Reactor," *Electrochem. Solid-State Lett.* **2(11)**, 592-594, Nov. 1999.

L. Pruette, S. Karecki, R. Chatterjee, R. Reif, T. Sparks, V. Vartanian, "Study of NF_3 -Based High Density Plasma Oxide Etch Processes for Reduced Global Warming Emissions," American Vacuum Society 46th National Symposium, Seattle, WA, October 25-29, 1999.

R. Chatterjee, S. Karecki, L. Pruette, R. Reif, V. Vartanian, T. Sparks, "Evaluation of Unsaturated Fluorocarbons for Dielectric Etch Applications," Electrochemical Society Fall Meeting, Honolulu, HI, Oct. 17-22, 1999, published in *Proceedings of the Electrochemical Society 99-30: Plasma Etching for Sub-Quarter Micron Devices* G. S. Mathad, Editor, The Electrochemical Society, Pennington, NJ (1999).

L. Pruette, S. Karecki, R. Reif, L. Tousignant, W. Reagan, S. Kesari, L. Zazzera, "Evaluation of C_4F_8O as an Alternative Plasma Enhanced Chemical Vapor Deposition Chamber Clean Chemistry," Electrochemical Society Spring Meeting, Seattle, WA, May 2-7, 1999, published in *Proceedings of the Electrochemical Society 99-8: Environmental Issues in the Electronics and Semiconductor Industries*, L. Mendicino, L. Simpson, Editors, pp. 20-29, The Electrochemical Society, Pennington, NJ (1999).

S. Karecki, L. Pruette, R. Chatterjee, and R. Reif, "Alternative Chemistries for Dielectric Etch Processes" (invited talk), Northern California Chapter of the American Vacuum Society Plasma Etch Users Group Meeting, Santa Clara, CA, March 2, 1999.

continued

Faculty, Research Staff, and Publications

continued

Caroline A. Ross

Lord Foundation Associate Professor of Materials Science

Department of Materials Science and Engineering (DMSE)

Collaborators

Prof. Henry I. Smith, EECS

Prof. Rajeev Ram, EECS

Dr. Mark Schattenburg, Center for Space Research

Tim Savas, Dept. of Physics

Postdoctoral Researcher

Mutsuhiro Shima, (DMSE)

Graduate Students

Douglas Twisselmann, MSE

Minha Hwang, MSE

Maya Farhoud, EECS

Yaowu Hao, MSE

Joy Cheng, MSE

Mike Walsh, EECS

Undergraduate Students

Yuh-Jer Shine, MSE

Publications

Savas, T.A., M. Farhoud, M. Hwang, H.I. Smith and C.A. Ross, "Properties of large-area nanomagnet arrays with 100 nm period made by interferometric lithography", *J. Appl. Physics* **85** 6160-2(1999)

Twisselmann, D.J., M. Farhoud, H.I. Smith and C.A. Ross, "In-plane magnetic anisotropy in CoCrPt and CoCrTa films deposited onto patterned silicon substrates", *J. Appl. Physics* **85** 4292-4 (1999)

Ross, C.A., T.A. Savas, H.I. Smith and R. Chantrell, "Modelling of hysteresis loops of arrays of 100 nm period nanomagnets", *IEEE Trans. Magn.* **35** 3781 (1999)

Wang J.Q., L.M. Malkinski, Y. Hao, C.A. Ross and C. O'Connor, "Fabrication of pseudo-spin-valves and 100 nm sized periodic elements for MRAM applications", *in press*, *J. Mater. Sci. Eng. A* (1999)

Farhoud, M., J. Ferrera, A.J. Lochtefeld, M.L. Schattenburg, C.A. Ross and H.I. Smith, "Fabrication of 200nm period nanomagnet arrays using interferometric lithography and a negative resist", *J. Vac. Sci. Technol.* **B17** 3182 (1999)

Ross, C.A., H.I. Smith, T. Savas, M. Schattenburg, M. Farhoud, M. Hwang, M. Walsh, M. Abraham, R. Ram "Fabrication of Patterned Media for High Density Magnetic Storage", *J. Vac. Sci. Technol.* **B17** 3168 (1999)

M. Hwang, M. C. Abraham, T.A. Savas, H.I. Smith, R.J. Ram and C.A. Ross "Magnetic force microscopy study of interactions in 100 nm period nanomagnet arrays", *in press*, *J. Appl. Phys.* (2000)

Wang J-Q., L.M. Malkinski, C.A. Ross, Y. Hao, M. Walsh and J.M. MacLaren, "Pseudo-spin-valves by sputtering with improved characteristics", *in press*, *J. Appl. Phys.* (2000)

Farhoud M., H.I. Smith, M. Hwang and C.A. Ross "The effect of spacing and aspect ratio on the magnetic anisotropy of particle arrays", *in press*, *J. Appl. Phys.* (2000)

Ross, C.A., R. Ranjan, K. Tang, M. Schabes, R. Sinclair, "Magnetic media: imaging", invited article for *Encyclopedia of Electrical and Electronic Engineering*, ed. J. Webster, **12** 1-6 (1999)

Ross, C.A., R. Ranjan, K. Tang, M. Schabes, R. Sinclair, "Magnetic media: magnetization reversal", invited article for *Encyclopedia of Electrical and Electronic Engineering*, ed. J. Webster, **12** 6-11 (1999)

Ross, C.A. "Patterned media", invited article for *Encyclopedia of Materials: Science and Technology*, ed. R.W. Chantrell (*in press*)

Henry I. Smith, D.J.D. Carter, J. Ferrera, D. Gil, J. Goodberlet, J.T. Hastings, M.H. Lim, M. Meinhold, R. Menon, E.E. Moon, C.A. Ross, T. Savas, M. Walsh, F. Zhang, "Soft x-rays for deep sub-100 nm lithography, with and without masks", *in press*, *Proc. Materials Research Society* (1999)

continued

Faculty, Research Staff, and Publications

continued

Mark L. Schattenburg
Principal Research Scientist
Center for Space Research (CSR)

Research Staff

J. M. Carter, Research Specialist, RLE
R. C. Fleming, Semiconductor Process Engineer, CSR
E. Murphy, Senior Technician, CSR
R. Heilmann, Postdoctoral Research Associate

Support Staff

D. Breslau, Project Technician Mechanical, CSR
S. Donovan, Senior Secretary, CSR

Graduate Students

C. Chen, Research Assistant, EECS
M. Farhoud, Research Assistant, EECS
P. Konkola, Research Assistant, Mech. E.
O. Mongrard, Research Assistant, Aero. Astro.
G. Monnelly, Research Assistant, Physics
D. Pflug, Research Assistant, EECS
M. Walsh, Research Assistant, EECS

Publications

Fabrication of 200 nm period nanomagnet arrays using interferometric lithography and a negative resist, M. Farhoud, J. Ferrera, A.J. Lochtefeld, M. L. Schattenburg, C. A. Ross, and H. I. Smith, *J. Vac. Sci. Technol. B* 17, 3182-3185 (1999).

Sub-100 nm metrology using interferometrically produced fiducials, M. L. Schattenburg, C. Chen, P. N. Everett, J. Ferrera, P. Konkola, and H. I. Smith, *J. Vac. Sci. Technol. B* 17, 2692-2697 (1999).

Fabrication of patterned media for high density magnetic storage, C. A. Ross, H. I. Smith, T. Savas, M. L. Schattenburg, M. Farhoud, M. Hwang, M. Walsh, M. C. Abraham, and R. J. Ram, *J. Vac. Sci. Technol. B* 17, 3168-3176 (1999).

A Holographic Phase-Shifting Interferometer Technique to Measure In-Plane Distortion, M.H. Lim, J. Ferrera, K.P. Pipe and Henry I. Smith, *J. Vac. Sci. Technol. B*, Nov/Dec 1999 (in press).

Segmented x-ray mirror development for Constellation-X, R. Petre, C. Chen, L. Cohen, D. Content, R. J. Harms, O. Mongrard, G. Monnelly, T. Saha, M. L. Schattenburg, and W. Zhang, *Proc. SPIE 3766, X-Ray Optics, Instruments, and Missions II*, eds. R. B. Hoover and A. B. C. Walker, Jr. (in press).

Large-area reflection grating spectrometer for the Constellation-X mission, S. M. Kahn, F. B. Paerels, J. R. Peterson, A. P. Rasmussen, M. L. Schattenburg, G. R. Ricker, Jr., M. W. Bautz, J. P. Doty, G. Y. Prigozhin, J. A. Nousek, D. N. Burrows, J. E. Hill, W. C. Cash, *Proc. SPIE 3765, EUV, X-ray, and Gamma-ray Instrumentation in Astronomy X*, eds. R. B. Hoover and A. B. C. Walker, Jr. (in press).

The Medium Energy Neutral Atom Imager on the IMAGE mission, C. Pollock et al., *J. Geophysics Res.* (in press).

continued

Faculty, Research Staff, and Publications

continued

Martin A. Schmidt

Professor

Department of Electrical Engineering and Computer Science (EECS)

Director

Microsystems Technology Laboratories (MTL)

Research Staff

A. Ayon, Research Scientist, MTL

A. Franz, Postdoctoral Associate, ChEng

R. Ghodssi, Research Scientist, GTL

K. Ishihara, Visiting Scientist, CAES

R. Jackman, Postdoctoral Associate, ChEng

R. Khanna, Research Engineer, MTL

H. Li, Postdoctoral Associate, Aero&Astro

C. Livermore, Postdoctoral Associate, MTL

Y. Peles, Postdoctoral Associate, GTL

T. Takas, Research Specialist, MTL

X. Zhang, Postdoctoral Associate, GTL

Graduate Students

R.A. Braff, NSF Fellow, ME

D.-Z. Chen, Research Assistant, ME

S. Firebaugh, NSF Fellow, EECS

C.-C. Lin, Research Assistant, MSE

S. Schaevitz, Research Assistant, EECS

C. Tsau, Research Assistant, MSE

J. Voldman, Kodak Fellow, EECS

J. Wong, Research Assistant, ME

X. Yang, Research Assistant, ME

C.-F. Yung, Research Assistant, EECS

Publications

A.A. Ayon, R. Braff, C.-C. Lin, H.H. Sawin, and M.A. Schmidt, "Characterization of a Time Multiplexed Inductively Coupled Plasma Etcher," *J. of the Electrochemical Soc.*, 146 (January 1999)

I.-M. Hsing, R. Srinivasan, M.P. Harold, K.F. Jensen, and M.A. Schmidt, "Simulation of Micromachined Chemical Reactors for Heterogeneous Partial Oxidation Reactions," *Chemical Engineering Science* (February 1999)

A. Mehra, A.A. Ayon, I.A. Waitz, and M.A. Schmidt, "Microfabrication of High-Temperature Silicon Devices Using Wafer Bonding and Deep Reactive Ion Etching," *IEEE/ASME J. of Microelectromechanical Systems* (March 1999)

A.A. Ayon, R.A. Braff, R. Bayt, H.H. Sawin, and M.A. Schmidt, "Influence of Coil Power on the Etching Characteristics in a High Density Plasma Etcher," *Journal of the Electrochemical Society* (July 1999)

A.A. Ayon, K. Ishihara, R.A. Braff, H.H. Sawin, and M.A. Schmidt, "Application of the Footing Effect in the Micromachining of Self-Aligned, Free-Standing, Complementary Metal-Oxide-Semiconductor Compatible Structures," *J. Vac. Sci. Technol. A* (Jul/Aug 1999)

A.A. Ayon, K. Ishihara, R.A. Braff, H.H. Sawin, and M.A. Schmidt, "Microfabrication and Testing of Suspended Structures Compatible with Silicon-On-Insulator Technology," *J. Vac. Sci. Technol. B* (Jul/Aug 1999)

J. Voldman, M.L. Gray, and M.A. Schmidt, "Microfabrication in Biology and Medicine," *Annu. Rev. Biomed. Eng.* (August 1999)

continued

Faculty, Research Staff, and Publications

Stephen D. Senturia

Barton L. Weller Professor

Department of Electrical Engineering and Computer Science (EECS)

Research Staff

C. Livermore, Postdoctoral Associate, MTL

J. Mehner, Visiting Scientist (has now returned to Chemnitz University, Germany)

Srikar Vengallatore, Postdoctoral Associate, MTL

Collaborators

A. Akinwande, Associate Professor, EECS

A. Epstein, Professor, Aeronautics and Astronautics

J. Lang, Professor, EECS

M. Schmidt, Professor, EECS

M. Spearing, Assistant Professor, Aero/Astro

C. Thompson, Professor, MSE

J. White, Professor, EECS

Graduate Students

E. Deutsch, Research Assistant, PhD Candidate, EECS

M. Hill, Research Assistant, MEng Candidate, EECS (now at Ford Motor Company)

M. Varghese, Research Assistant, PhD Candidate, EECS

A. Volpicelli, Research Assistant, PhD Candidate, EECS

Y.-J. Yang, PhD Candidate, EECS (now at Microcosm Technologies)

Undergraduate Students

Raj Sood, UROP Student, EECS

Publications

E. S. Hung and S. D. Senturia, "Generating Efficient Dynamical Models for Microelectromechanical Systems from a Few Finite-Element Simulation Runs," *J. Microelectromechanical Systems*, **8**, 280-289 (1999).

L. Castañer and S. D. Senturia, "Speed-Energy Optimization of Electrostatic Actuators Based on Pull-In," *J. Microelectromechanical Systems*, **8**, 290-298, (1999).

E. S. Hung and S. D. Senturia, "Extending the Travel Range of Analog-Tuned Electrostatic Actuators," *J. Microelectromechanical Systems*, **8**, 497-505 (1999).

M. Varghese, V. L. Rabinovich, and S. D. Senturia, "Reduced-Order Modeling of Lorentz Force Actuation with Modal Basis Functions," *Proc. 2nd Int'l. Conf. on Modeling and Simulation of Microstructures (MSM 99)*, San Juan, Puerto Rico, April 19-21, 1999, pp. 155-158.

A. Volpicelli, E. R. Deutsch, S. D. Senturia, "Use of Computer Microvision to Automate Electrostatic Material Property Measurement Procedures," *Proc. Int'l. Conf. On Solid-State Sensors and Actuators (Transducers '99)*, Sendai, Japan, June 1999, pp. 920-923.

R. Ghodssi, L. G. Frechette, S. F. Nagle, X. Zhang, A. A. Ayon, S. D. Senturia, and M. A. Schmidt, "Thick Buried Oxide in Silicon (TBOS): An Integrated Fabrication Technology for Multi-Stack Wafer-Bonded MEMS Processes," *Proc. Int'l. Conf. On Solid-State Sensors and Actuators (Transducers '99)*, Sendai, Japan, June 1999, pp. 1456-1459.

L. Castañer, A. Rodríguez, J. Pons, and S. D. Senturia, "Measurement of Power-Speed Product of Electrostatic Actuators," *Proc. Int'l. Conf. On Solid-State Sensors and Actuators (Transducers '99)*, Sendai, Japan, June 1999, pp. 1772-1775.

M. J. Kobrinisky, E. R. Deutsch, and S. D. Senturia, "Influence Of Support Compliance And Residual Stress On The Shape Of Doubly-Supported Surface-Micromachined Beams," *Int'l. Mechanical Engineering Congress, Symposium on Micro-Electro-Mechanical Systems (ASME-MEMS 1999)*, Nashville, Tennessee, November 1999, Vol. 1, pp. 3-10.

Faculty, Research Staff, and Publications

continued

Henry I. Smith
Joseph F. and Nancy P. Keithley Professor of
Electrical Engineering (EE)
Director
Nanostructures Laboratory (NSL)

L. Castañer and S. D. Senturia, "Effect of source resistance on the speed and energy dissipation of electrostatic pull-in actuators," *Actas de la Conferencia CDE 99*, Madrid, Spain pp. 25-28, 1999.

L. D. Gabbay, J. E. Mehner, and S. D. Senturia, "Computer-Aided Generation of Nonlinear Reduced-Order Dynamic Macromodels: I. Non-Stress-Stiffened Case," *J. Microelectromechanical Systems*, *9*, in press.

J. E. Mehner, L. D. Gabbay, and S. D. Senturia, "Computer-Aided Generation of Nonlinear Reduced-Order Dynamic Macromodels: II. Stress-Stiffened Case," *J. Microelectromechanical Systems*, *9*, in press.

L. Castañer, A. Rodríguez, J. Pons and S.D. Senturia, "Pull-in time-speed product of electrostatic actuators: comparison of experiments with simulation," *Sensors and Actuators (A)*, in press.

Academic and Research Staff

Dr. David J.D. Carter
James M. Carter
Robert C. Fleming
Dr. James G. Goodberlet
Mark. K. Mondol
Dr. Mark L. Schattenburg

Visiting Scientists and Research Affiliates

Dr. Patrick N. Everett
Ken-ichi Murooka.

Graduate Students

A. Bernshteyn, Research Assistant, EECS
Carl Chen, Research Assistant, EECS
Joy Cheng, Research Assistant, CMSE
A. Erchak, Research Assistant, CMSE
M. Farhoud, Research Assistant, EECS
J. Ferrera, Research Assistant, EECS
D. Gil, Research Assistant, EECS
J. Hastings, Research Assistant, EECS
Y. Hao, Research Assistant, CMSE
M. Hwang, Research Assistant, CMSE
K. M. Jackson, Research Assistant, EECS
J. Kahn, Research Assistant, EECS
P. Konkola, Research Assistant, EECS
M. Lim, Research Assistant, EECS
A. Lochtefeld, Research Assistant, EECS
M. Meinhold, Research Assistant, EECS
R. Menon, Research Assistant, EECS
E. Moon, Research Assistant, EECS
T. Murphy, Research Assistant, EECS
D. Pflug, Research Assistant, EECS
M. Qi, Research Assistant, CMSE
F. Rana, Research Assistant, EECS
T. A. Savas, Research Assistant, Physics
M. Walsh, Research Assistant, EECS
Feng Zhang, Research Assistant, EECS

Faculty, Research Staff, and Publications

continued

Technical and Support Staff

James Daley, Senior Technician, RLE

Cynthia Lewis, Administrative Assistant, RLE

Publications

D.J. Twisselmann, M. Farhoud, H.I. Smith and C.A. Ross, "In-Plane Magnetic Anisotropy in CoCrPt and CoCrTa Films Deposited Onto Patterned Silicon Substrates", *J. Appl. Physics*, **85**, 4292-4294 (1999).

T.A. Savas, M. Farhoud, H. I. Smith, M. Hwang, and C.A. Ross, "Properties of large-area nanomagnet arrays with 100 nm period made by interferometric lithography" *J. Appl. Physics*, **85**, 6160-6162 (1999).

K-Y Lim, D.J. Ripin, G.S. Petrich, L.A. Kolodziejski, E.P. Ippen, M. Mondol, H.I. Smith, P.R. Villeneuve, S. Fan, J.D. Joannopoulos, "Photonic bandgap waveguide microcavities: monorails and air-bridges", *J. Vac. Sci. Technol. B* **17**(3), May / June (1999).

E.M. Koontz, G.D. U'Ren, M.H. Lim, L.A. Kolodziejski, M.S. Goorsky, G.S. Petrich, and Henry I. Smith, "Overgrowth of (In,Ga)(As,P) on Rectangular-Patterned Surfaces Using Gas Source Molecular Beam Epitaxy", *Journal of Crystal Growth* **198/199** 1104—1110 (1999).

J.O. Choi, H.S. Jeong, D.G. Pflug, A.I. Akinwande and H.I. Smith, "Fabrication of 0.1 μm gate aperture Mo-tip field-emitter arrays using interferometric lithography" *Appl. Phys. Lett.*, **74** (20), 3050-3052 (1999).

M.L. Schattenburg, C. Chen, P.N. Everett, J. Ferrera, P. Konkola, and Henry I. Smith, "Sub-100 nm metrology using interferometrically produced fiducials (invited)", *J. Vac. Sci. Technol. B* **17**(6), 2692-2697 (1999).

E.E. Moon, P. N. Everett, M. Meinhold, M. Mondol and Henry I. Smith, "A Novel Mask-Wafer Gap-Measurement Scheme with Nanometer-Level Detectivity", *J. Vac. Sci. Technol. B*, **17**(6), 2698-2702 (1999).

M.H. Lim, T.E. Murphy, J. Ferrera, J.N. Damask and Henry I. Smith, "Fabrication Techniques for Grating-Based Optical Devices", *J. Vac. Sci. Technol. B*, **17**(6), 3208-3211 (1999).

M.H. Lim, J. Ferrera, K.P. Pipe and Henry I. Smith, "A Holographic Phase-Shifting Interferometer Technique to Measure In-Plane Distortion", *J. Vac. Sci. Technol. B* **17**(6), 2703-2706 (1999).

D.J.D. Carter, D. Gil, R. Menon, M. Mondol and Henry I. Smith, "Maskless, Parallel Patterning with Zone-Plate Array Lithography (ZPAL)", *J. Vac. Sci. Technol. B* **17**(6) 3449-3452 (1999).

M. Farhoud, J. Ferrera, A.J. Lochtefeld, M.L. Schattenburg, C.A. Ross and Henry I. Smith, "Fabrication of 200 nm period nanomagnet arrays using interferometric lithography and a negative resist", *J. Vac. Sci. Technol. B*, **17**(6), 3182-3185 (1999).

C. A. Ross, H.I. Smith, T. Savas, M. Schattenburg, M. Farhoud, M. Hwang, M. Walsh, M. Abraham, R. Ram, "Fabrication of Patterned Media for High Density Magnetic Storage (invited)", *J. Vac. Sci. Technol. B*, **17**(6) 3168-3176 (1999).

R.E. Grisenti, W. Schollkopf, J.P. Toennies, G.C. Hegerfeldt and T. Kohler, "Determination of Atom-Surface van der Waals Potentials from Transmission-Grating Diffraction Intensities", *Phys. Rev. Lett.*, **83**(9), 1755-1758 (1999).

C.A. Ross, T.A. Savas, H.I. Smith, M. Hwang and R. Chantrell, "Modelling of Hysteresis Loops of Arrays of 100 nm Period Nanomagnets", *IEEE. Trans. Magnetics*, **35**, 3781-3783 (1999).

Faculty, Research Staff, and Publications

continued

R.E. Grisenti, W. Schoellkopf, J.P. Toennies, J.R. Manson, T.A. Savas and H.I. Smith, "He Atom Diffraction from Nanostructured Transmission Gratings: The Role of Imperfections", Submitted to *Phys. Rev. A*, March 1999.

D. G. Pflug, M. Schattenburg, H.I. Smith and A.I. Akinwande, "Mo Cone field Emission Arrays with 100-nm Gate Aperture", submitted to *Electron Device Letters*, 1999.

J. Goodberlet, "A Very-High-Density Scintillation-Data-Storage Device", *Microelectronic Engineering* 46 145-148 (1999).

D.J.D. Carter, H.I. Smith, K.W. Rhee and C. Marrian, "Sub-40nm pattern replication with +/- 20% process latitude by soft contact x-ray lithography", *Proceedings of SPIE's 24th Annual International Symposium on Microlithography, Emerging Lithographic Technologies III*, 14-19 March 1999, Santa Clara, CA. SPIE vol. 3676, pp.70-78 (1999).

D.J.D. Carter, D. Gil, R. Menon, I. J. Djomehri and Henry I. Smith, "Zone-Plate Array Lithography (ZPAL): A new maskless approach", *Proceedings of SPIE's 24th Annual International Symposium on Microlithography, Emerging Lithographic Technologies III* 14-19 March 1999, Santa Clara, CA. SPIE vol. 3676, pp.324-332 (1999).

T. E. Murphy, B. E. Little and H. I. Smith, "Wavelength- and Polarization-Insensitive Integrated Directional Couplers using Mach-Zehnder Structures," in *Integrated Photonics Research, OSA Technical Digest*, pp. 138-140, July (1999).

J.T. Hastings, F. Zhang, A. Bernshteyn, J.G. Goodberlet and H.I. Smith, "Improved Pattern-Placement Accuracy in E-Beam Lithography Via Sparse-Sample Spatial-Phase Locking", Submitted to *Micro & Nano Engineering*, (1999).

J.G. Goodberlet, B.L. Dunn, "Deep-Ultraviolet Contact Photolithography", Submitted to *Micro & Nano Engineering*, (1999).

H.I. Smith, "Soft x-rays for deep sub- 100 nm lithography, with and without masks", Submitted to *Micro & Nano Engineering*, (1999).

R. Menon, D. J. D. Carter, D. Gil, and H. I. Smith, "Zone-Plate-Array Lithography (ZPAL): Simulations for System Design", to be published in the *Proceedings of the Vth International Conference on X-ray Microscopy (XRM99)*, Berkeley, CA., August 1-6 (1999).

H. I. Smith, D. J. D. Carter, J. Ferrera, D. Gil, J. Goodberlet, J. T. Hastings, M. H. Lim, M. Meinhold, R. Menon, E. E. Moon, C. A. Ross, T. Savas, M. Walsh, F. Zhang, "Soft X-Rays for Deep Sub-100 NM Lithography, with and without masks", *Materials Research Society Meeting*, Boston, MA., November 29-December 2 (1999).

K. Murooka, M. H. Lim, J. Ferrera, and Henry I. Smith, "X-ray lithography below 100 nm: An approach to eliminating distortion", *XEL 1999*, Yokohama, Japan, November 1999.

Henry I. Smith, "Nanolithography on limited budgets; why this is important", University of Canterbury, Department of Electronic and Electrical Engineering, January 25, 1999.

D. Gil, "ZPAL: A New Maskless Approach", presented at the MTL poster session, January 11, 1999.

H. I. Smith, "Nanostructures at MIT – why I came to Göttingen", Forschungseinrichtung Röntgenphysik, Göttingen, Germany, March 24, 1999.

H. I. Smith, "Nanolithography in the next century: How will it be done and for what applications", Max-Planck-Institute Fur Strömungsforschung, Göttingen, Germany, April 16, 1999.

Faculty, Research Staff, and Publications

continued

Charles G. Sodini

Professor

**Department of Electrical Engineering
and Computer Science (EECS)**

Carl V. Thompson

**Stavros Salapatas Professor of Materials
Science and Engineering,
Department of Materials Science
and Engineering (DMSE)**

Graduate Students

P. Accosta Serafini, Research Assistant, EECS
I. L. Fujimori, Lucent Technologies GRPW Fellow, EECS
D. A. Hitko, Hughes Fellow, EECS
D. McMahill, Research Assistant, EECS
N. Shnidman, Research Assistant, EECS
A. Wang, NSF Fellow, EECS
C. C. Wang, Research Assistant, EECS

Support Staff

P. Varley, Administrative Assistant, MTL

Publications

Gealow, J.C. and C.G. Sodini, "A Pixel-Parallel Image Processor Using Logic Pitch-Matched to Dynamic Memory," *IEEE Journal of Solid-State Circuits*, 34, 831, June, 1999.

Fujimori, I. L., C. C. Wang, C. G. Sodini, "A 256 X 256 differential Passive Pixel Imager with FPN Reduction Techniques," presented at the 1999 International Solid-State Circuits Conference, ISSCC, February, 2000.

Collaborators, Visiting Scientists, and Research Affiliates

Jerrold A. Floro, Sandia National Laboratory
Harold J. Frost, Professor, Thayer School,
Dartmouth College
Mihal Gross, Lucent
Steven Senturia, Professor, EECS, MIT
Galen Straub, Los Alamos National Laboratory
Subra Suresh, Professor, MSE, MIT
Donald Troxel, Professor, EECS, MIT

Graduate Students

Vaibhav Andleigh, Research Assistant, MSE
Robert Bernstein, Research Assistant, MSE
Yonald Chery, Research Assistant, EECS
Walid Fayad, Research Assistant, Civ.E.
Christine Hau-Riege, NSF Fellow, MSE
Stefan Hau-Riege, SRC Fellow, MSE
Mauro J. Kobrinsky, Research Assistant, MSE
Ramkumar Krishnan, Research Assistant, MSE
Felix Lau, Research Assistant, MSE
Steven C. Seel, Research Assistant, MSE

Support Staff

Robert D. Fadel, Administrative Assistant, MSE

Publications

Y.-C. Joo, C.V. Thompson, S.P. Baker, and E. Arzt, *Electromigration Proximity Effects of Two Neighboring Fast-Diffusion Segments in Single-Crystal Aluminum Lines*, *J. Appl. Phys.* **85**, 2108 (1999).

W.Fayad, C.V. Thompson, and H.J. Frost, *Steady State Grain Size Distributions Resulting from Grain Growth in Two Dimensions*, *Scripta Mater* **40**, 1199 (1999).

S.P. Riege, C.V. Thompson, and H.J. Frost, *Simulation of the Influence of Particles on Grain Structure Evolution in 2-D Systems and Thin Films*, *Acta Materialia* **47**, 1879 (1999).

Faculty, Research Staff, and Publications

continued

V.T. Srikar and C.V. Thompson, *Diffusion and Electromigration of Copper in SiO₂-Passivated Single-Crystal Aluminum Interconnects*, Applied Physics Letters **74**, 37 (1999).

V.T. Srikar and C.V. Thompson, *Dislocation Pile-ups as Sites for Formation of Electromigration-Induced Transgranular Slit-like Voids in Interconnects*, Scripta Materialia **42**, 97 (2000).

S.P. Riege and C.V. Thompson, *Modeling of Texture Evolution in Copper Interconnects Annealed in Trenches*, Scripta Materialia **41**, 403 (1999).

H. Gao, L. Zhang, W.D. Nix, C.V. Thompson, and E. Arzt, *Crack-Like Grain Boundary Diffusion Wedges in Thin Metal Films*, Acta Materialia **47**, 2865 (1999).

Y.-J. Park, V.K. Andleigh, and C.V. Thompson, *Simulations of Stress Evolution and the Current-density Scaling of Electromigration-Induced failure Times in Pure and Alloyed Interconnects*, J. Appl. Phys. **85**, 3546 (1999).

C.S. Hau-Riege and C.V. Thompson, *Microstructural Evolution Induced by Scanned Laser Annealing in Al Interconnects*, Appl. Phys. Lett. **75**, 1464 (1999).

V.K. Andleigh, V.T. Srikar, Y.T. Park, and C.V. Thompson, *Mechanism Maps for Electromigration-Induced Failure of Metal and Alloy Interconnects*, J. of Appl. Phys. **86**, 6737 (1999).

C.V. Thompson, *On the Grain Size and Coalescence Stress Resulting from Nucleation and Growth Processes During Formation of Polycrystalline Thin Films*, J. Mater Res. **14**, 3164 (1999).

M.J. Kobrinsky and C.V. Thompson, *Activation Volume for Inelastic Deformation in Polycrystalline Ag Thin Films*, Acta Mater. **00**, 1 (2000).

J. Greiser, P. Mullner, C.V. Thompson, and E. Arzt, *Growth of Giant Grains in Silver Thin Films*, Scripta Materialia **41**, 70 (1999).

C. V. Thompson, V. Andleigh, and S.P. Hau-Riege, *Modeling and Experimental Characterization of Electromigration in Interconnect Trees*, 5th International Workshop, Stuttgart, Germany, AIP Conference Proceedings, **491**, 62 (1999).

Y.-C. Joo, S.P. Baker, E. Arzt, C.V. Thompson *Model Studies of Electromigration Using Indented Single-Crystal Aluminum Lines*, 5th International Workshop, Stuttgart, Germany, AIP Conference Proceedings, **491**, 100 (1999).

Faculty, Research Staff, and Publications

continued

H. L. Tuller

**Professor of Ceramics & Electronic Materials, Crystal Physics and Electroceramics Laboratory,
Department of Materials Science and Engineering (DMSE)**

Research Staff

H. Fritze, Post-Doctoral Associate, DMSE
A.C. Palanduz, Post-Doctoral Associate, DMSE
M. Spears, Post-Doctoral Associate, DMSE
R. Mlcak, Research Affiliate, DMSE
H. Takamura, Visiting Scientist, DMSE

Graduate Students

Y. Avrahami, Research Assistant, DMSE
C. Navas, Research Assistant, Chemistry
H. Seh, Research Assistant, DMSE
J. Sprague, Research Assistant, DMSE
T. Stefanik, Research Assistant, DMSE
Y.K. Min, Research Assistant, DMSE

Publications

P. Knauth and H.L. Tuller, "Electrical and Defect Thermodynamic Properties of Nanocrystalline Titanium Dioxide", *J. Appl. Phys.*, **85**, 897-902 (1999).

H.L. Tuller, "ZnO Grain Boundaries: Electrical Activity and Diffusion", *J. Electroceram.*, **4**:51, 33-40 (1999).

C. Navas, H.L. Tuller & H.-C. zur Loye, "Electrical Conductivity and Nonstoichiometry in Doped $\text{Sr}_3\text{Ti}_2\text{O}_7$ ", *J. Euro. Ceram. Soc.* **19**, 737-740 (1999).

P. Knauth and H.L. Tuller, "Nonstoichiometry and Relaxation Kinetics of Nanocrystalline Mixed Praseodymium-Cerium Oxide $\text{Pr}_{0.7}\text{Ce}_{0.3}\text{O}_{2-x}$ ", *J. Euro. Ceram. Soc.*, **19**, 831-836 (1999).

C. Heremans and H.L. Tuller, "Lead Hafnate Zirconate Titanate-based Perovskite Materials for Acuatation", *J. Euro. Ceram. Soc.*, **19**, 1133-1137 (1999).

J.J. Sprague and H.L. Tuller, "Mixed Ionic and Electronic Conduction in Mn/Mo Doped Gadolinium Titanate", *J. Euro. Ceram. Soc.*, **19**, 803-806 (1999).

P. Knauth, Y. Massiani, M. Pasquinelli and H.L. Tuller, "Electrochemical and Semiconductor Properties of Polycrystalline Copper(I) Bromide", *Electrochemistry of Glass and Ceramics Symposium, 100th Annual Meeting of the American Ceramic Society, Cincinnati, OH, May 3-6, 1998. Ceramic Transactions, Vol. 92, in press.*

P. Knauth and H.L. Tuller, "Thermodynamic Properties of Non-Stoichiometric Praseodymium-Cerium Oxide $\text{Pr}_{0.7}\text{Ce}_{0.3}\text{O}_{2-x}$ ", *Electrochemistry of Glass and Ceramics Symposium, 100th Annual Meeting of the American Ceramic Society, Cincinnati, OH, May 3-6, 1998. Ceramic Transactions, Vol. 92, in press.*

H.L. Tuller and R. Mlcak, "Advanced Sensor Technology Based on Oxides Thin Films – MEMS Integration", *J. Electroceramics*, in press.

J. Schoonman, H.L. Tuller and E.M. Kelder, "Defect Chemical Aspects of Lithium-ion Battery Cathodes", *J. Power Sources*, **81-82**, 44-48 (1999).

J.J. Sprague and H.L. Tuller, "Mixed Ionic and Electronic Conduction in Mn/Mo Doped Gadolinium Titanate", *Solid State Ionics V(MRS Proc. Vol. 548)*, G.-A. Nazri, C. Julien, and A. Rougier, eds. Materials Research Society, Warrendale, PA, 1999, pp. 527-532.

H. Takamura and H.L. Tuller, "The Synthesis and Electrical Conductivity of Novel Mixed Ionic and Electronic Conductors in the $\text{Gd}_2\text{GaSbO}_7\text{-Gd}_2\text{Zr}_2\text{O}_7$ Solid Solution", *Solid State Ionics V(MRS Proc. Vol. 548)*, G.-A. Nazri, C. Julien, and A. Rougier, eds. Materials Research Society, Warrendale, PA, 1999, pp. 539-543.

C. Navas, H.L. Tuller, and H.-C. zur Loye, "New Mixed Conductors Based on Doped Layered Perovskites", *Solid State Ionics V(MRS Proc. Vol. 548)*, G.-A. Nazri, C. Julien, and A. Rougier, eds. Materials Research Society, Warrendale, PA, 1999, pp. 533-538.

Faculty, Research Staff, and Publications

continued

Jacob K. White
Professor
**Department of Electrical Engineering
and Computer Science (EECS)**

H. Fritze, H.L. Tuller, J. Berthold and B. Schultrich, "Mechanisms and Kinetics of Electrochemical Intercalation of Oxygen into $\text{Nd}_2\text{NiO}_{4+}$ ", Solid State Ionics V(MRS Proc.Vol. 548), G.-A. Nazri, C. Julien, and A. Rougier, eds. Materials Research Society, Warrendale, PA, 1999, pp.575-580.

P. Knauth and H.L. Tuller, "How Unique are the Microstructure and the Electrical Properties of Nanocrystalline Ceramics", Solid State Ionics V(MRS Proc.Vol. 548), G.-A. Nazri, C. Julien, and A. Rougier, eds. Materials Research Society, Warrendale, PA, 1999, pp. 429-442.

N.J. Long, F. Lecarpentier and H.L. Tuller, "Structure and Electrical Properties of Ni-substituted Lanthanum Gallate Perovskites", J. Electroceramics, **3:4**, 399-407, 1999.

H. Fritze, H.L. Tuller, G. Borchardt and T. Fukuda, "High Temperature Properties of Langasite", Symposium on Smart Materials, R. Gotthardt, K. Uchino, Y. Ito, and M. Wun-Fogle, Eds., Materials Research Society Fall Meeting, Boston, MA, Nov. 30-Dec. 2, 1999. Accepted for publication.

Takamura and H.L. Tuller, "Ionic Conductivity of $\text{Gd}_2\text{GaSbO}_7 - \text{Gd}_2\text{Zr}_2\text{O}_7$ Solid Solutions with Structural Disorder.", Solid State Ionics, accepted for publication.

H.L. Tuller, "Ionic Conduction in Nanocrystalline Materials", Solid State Ionics, accepted for publication. Invited.

Publications

L. M. Silveira, I. Elfadel, M. Kamon and J. White, "A Coordinate-Transformed Arnoldi Algorithm for Generating Guaranteed Stable Reduced-Order Models of RLC Circuits, Special Issue of Comp. Methods in Appl. Mech. and Eng. on Advances in Comp. Methods in Electromagnetics, February 1999, Vol. 169/3-4, pp. 377-389

M. Kamon, N. Marques, L. M. Silveira and J. White, "Automatic generation of Accurate Circuit Models of 3-D Interconnect", IEEE Transactions on Components, Packaging, and Manufacturing Technology — Part B: Advanced Packaging, August, 1998, vol. 21, no. 3, pp. 225-240

D. Ramaswamy, W. Ye, X. Wang and J. White, "Fast Algorithms for 3-D Simulation," Journal of Modeling and Simulation of Microsystems, Vol. 1, No. 1, pp. 77-82, December, 1999.

Y. Massoud, J. Wang, and J. White, "Accurate Inductance Extraction with Permeable Materials Using Qualocation,". To appear International Conference on Modeling and Simulation of Microsystems, Semiconductors, Sensors and Actuators, San Juan, April 1999.

J. Wang, J. Tausch, and J. White, "A Wide Frequency Range Surface Integral Formulation for 3-D Inductance and Resistance Extraction,". To appear International Conference on Modeling and Simulation of Microsystems, Semiconductors, Sensors and Actuators, San Juan, April 1999

J. White, "Fast Algorithms for 3-D Simulation,". To appear International Conference on Modeling and Simulation of Microsystems, Semiconductors, Sensors and Actuators, San Juan, April 1999

Faculty, Research Staff, and Publications

continued

W. Ye, J. Kanapka, X. Wang and J. White, "Efficiency and Accuracy Improvements for FastStokes, A Precorrected-FFT Accelerated 3-D Stokes Solver,". To appear International Conference on Modeling and Simulation of Microsystems, Semiconductors, Sensors and Actuators, San Juan, April 1999

W. Ye, J. Kanapka, and J. White, "A Fast 3D Solver for Unsteady Stokes Flow with Applications to Micro-Electro-Mechanical Systems," International Conference on Modeling and Simulation of Microsystems, Semiconductors, Sensors and Actuators, San Juan, April 1999

J Li and J. White "Solution of Low Rank Input Lyapunov Equations by Vector Alternate Direction Implicit Iteration using a Rational Krylov Subspace Approach, with Application to Model Order Reduction," *Proceedings of the 35th Design Automation Conference*, New Orleans, June 1999.

D. Ramaswamy, N. Aluru and J. White, "Fast Coupled-Domain," Mixed-Regime Electromechanical Simulation Proc. Int'l Conference on Solid-State Sensors and Actuators (Transducers '99), Sendai Japan, June, 1999 pp. 314-317

J. Wang, J. Tausch, and J. White, "A Wide Frequency Range Surface Formulation for 3-D RLC Extraction," *Proceedings of the IEEE Conference on Computer-Aided Design*, San Jose, November, 1999.

J. Li and J. White, "Efficient Model Reduction of Interconnect Via Approximate System Grammians," *Proceedings of the IEEE Conference on Computer-Aided Design*, San Jose, November, 1999.

Y. Chen and J. White, "A Quadratic Method for Nonlinear Model Order Reduction." To appear, *International Conference on Modeling and Simulation of Microsystems, Semiconductors, Sensors and Actuators*, San Diego, March 2000

X. Wang, J. N. Newman and J. White, "Robust Algorithms for Boundary-Element Integrals on Curved Surfaces." To appear, *Intl. Conference on Modeling and Simulation of Microsystems, Semiconductors, Sensors and Actuators*, San Diego, March 2000

W. Ye, X. Wang, and J. White, "A Fast Stokes Solver for Generalized Flow Problems." To appear, *Intl. Conference on Modeling and Simulation of Microsystems, Semiconductors, Sensors and Actuators*, San Diego, March 2000