

SANG M. HAN

Curriculum Vitae

EDUCATION

University of California - Santa Barbara

Ph.D. Chemical Engineering, 1993 – 1998

University of California - Berkeley

B.S. Chemical Engineering with Honors, 1988 – 1992

PROFESSIONAL EXPERIENCE

7/12 – present

Professor; Department of Chemical & Nuclear Engineering and Electrical & Computer Engineering; University of New Mexico, NM:

Maintain and advance a research program with emphasis on semiconductor materials science and engineering, fabrication, and their technological applications. Current research topics encompass (1) selective growth of Ge quantum structures and high-quality Ge heteroepitaxial films on Si; (2) III-V integration on engineered Ge-on-Si virtual substrates for photovoltaic, electronic, and sensor applications; (3) hybrid micro/nanofluidic systems for advanced bioseparation and analysis; (4) synthetic modification of semiconductor surfaces; and (5) nanocrystal synthesis and surface functionalization for nonlinear optical and biological applications.

1/10 – 6/12

Associate Professor; Department of Electrical and Computer Engineering; University of New Mexico, NM

7/06 – 6/12

Associate Professor; Department of Chemical and Nuclear Engineering; University of New Mexico, NM

4/00 – 6/06

Assistant Professor; Department of Chemical and Nuclear Engineering; University of New Mexico, NM

11/99 – 4/00

Post-doctoral Researcher with Dr. Neil Benjamin; Lam Research Corporation, Fremont, CA:

Engineered prototype hardware to facilitate low-pressure plasma ignition in electronegative discharges. Designed and characterized capacitive divider probes to measure high-frequency plasma potential variations in real time.

11/98 – 10/99

Post-doctoral Researcher with Dr. Roya Maboudian; Department of Chemical Engineering; U. C. Berkeley, CA:

Conducted surface passivation studies on Ge for MEMS applications using a variety of ultra-high vacuum (UHV) diagnostics such as X-ray photoelectron spectroscopy (XPS), high-resolution electron energy loss spectroscopy (HREELS), Auger electron spectroscopy (AES), low energy electron diffraction (LEED), and temperature programmed desorption (TPD).

9/93 – 10/98

Graduate Research Assistant with Professor Eray Aydil; Department of Chemical Engineering, U.C. Santa Barbara, CA:

Investigated gas phase and surface chemistry during plasma enhanced chemical vapor deposition (PECVD) of SiO₂ and fluorinated SiO₂ films using multiple diagnostics such as attenuated total reflection Fourier transform infrared (ATR-FTIR) spectroscopy, optical emission spectroscopy (OES), Langmuir probe measurements, and mass spectrometry.

8/96 – 10/96

Visiting NSF Scholar at Seoul National University, Korea:

Studied N incorporation in GaN films during remote plasma enhanced metal organic chemical vapor deposition (RPE-MOCVD) from TEGa and N₂ using OES and Langmuir

probe.

- 6/96 – 8/96 **Visiting NSF Scholar at Tokyo Institute of Technology, Japan:**
Developed a continuous thermal process to deposit stacked layers of polycrystalline Si and SiGe films on glass substrate using Si₂H₆ and GeF₄ for thin film transistors (TFT) used in active matrix liquid crystal displays (AMLCD).
- 6/94 – 8/94 **Summer Intern at Lam Research Corporation, Fremont, CA:**
Participated in product development. Performed radio frequency power studies in a transformer coupled plasma (TCP) reactor to assess the impact of ion mass and energy on SiO₂ film properties.
- 12/92 – 9/93 **Process Engineer at Lam Research Corporation, Fremont, CA:**
Demonstrated to customers, such as IBM, Motorola, Cypress, and Hyundai, system performance of Rainbow polysilicon plasma etchers. Served as a translator for TCP start-up at Samsung and LG.

PUBLICATIONS

1. Louis J. Tribby, Cornelius F. Ivory, Frank von Swol, and Sang M. Han, "Experimental characterization and modeling of aspect-ratio-dependent diffusion of nanocrystals in nanochannels," *Phys. Rev E*, in preparation (2013).
2. Youn-Jin Oh, Louis Tribby, Cornelius F. Ivory, and Sang M. Han, "High-Resolution Focusing and Separation of Proteins in Nanofluidic Channels," *Nature Lett.* in preparation (2013).
3. Swapnadip Ghosh, Darin Leonhardt, and Sang M. Han, "Effect of threading dislocation density and dielectric layer on temperature-dependent dc characteristics of metal semiconductor field effect transistors fabricated on epitaxially grown Ge on Si substrates," *IEEE Trans. Electron Dev.* in preparation (2013).
4. Josephine J. Sheng, Darin Leonhardt, Sang M. Han, Steven W. Johnston, Jeffrey G. Cederberg, and Malcolm S. Carroll, "Empirical Correlation for Minority Carrier Lifetime to Defect Density Profile in Germanium on Silicon Grown by Nanoscale Interfacial Engineering," *J. Vac. Sci. Technol. B*, accepted (2013).
5. W. C. T. Lee, N. Bishop, D. L. Thompson, K. Xue, G. Scappucci, J. G. Cederberg, J. K. Gray, S. M. Han, G. K. Celler, M. S. Carroll, and M. Y. Simmons, "Thermal processing of strained silicon-on-insulator for atomically precise silicon device fabrication," *Appl. Surf. Sci.*, **265**, 833-838 (2013).
6. Claire Y. Chuang, Qiming Li, Darin Leonhardt, Sang M. Han, and Talid Sinno, "Atomistic Analysis of Ge on Amorphous SiO₂ using an Empirical Interatomic Potential," *Surf. Sci.* **609**, 221-229 (2013).
7. Swapnadip Gosh, Darin Leonhardt, and Sang M. Han, "Investigations on Thermal Stress Relief Mechanism Using Air-Gapped SiO₂ Nanotemplates during Epitaxial Growth of Ge on Si and Corresponding Hole Mobility Improvement," *ECS Trans.* **45**(4), 111-114 (2012). DOI: 10.1149/1.3700459
8. Darin Leonhardt and Sang M. Han, "New Method to Produce High-Quality Epitaxial Ge on Si Using SiO₂-Lined Etch Pits and Epitaxial Lateral Overgrowth for III-V Integration," *ECS Trans.* **45**(4), 147-149 (2012). DOI: 10.1149/1.3700464
9. Josephine J. Sheng, David C. Chapman, David M. Wilt, Stephen J. Polly, Christopher G. Kerestes, Seth M. Hubbard, and Sang M. Han, "Temperature Dependent Characterization of Imbedded InAs Quantum Dots in GaAs Superlattice Solar Cells Structures by High Resolution X-ray Diffraction," *MRS Proc.* **1432** (2012). DOI: <http://dx.doi.org/10.1557/opl.2012.1139>
10. Swapnadip Ghosh, Darin Leonhardt, and Sang M. Han, "Experimental and theoretical investigation of stress relief during epitaxial growth of Ge on Si using air-gapped SiO₂ nanotemplates," *Appl. Phys. Lett.*, **99**(18),

- 181911 (2011) and *Virtual Journal of Nanoscale Science & Technology* (November 21, 2011). DOI: 10.1063/1.3659320
11. Darin Leonhardt, Swapnadip Ghosh, and Sang M. Han, "Defects in Ge Growth in Trench Patterned SiO₂ on Si and Ge substrates," *J. Cryst. Growth*, **335**(1), 62-65 (2011). DOI: 10.1016/j.jcrysgro.2011.09.022
 12. Darin Leonhardt and Sang M. Han, "Dislocation Reduction in Heteroepitaxial Ge on Si Using SiO₂ Lined Etch Pits and Epitaxial Lateral Overgrowth," *Appl. Phys. Lett.*, **99**(11), 111911 (2011). DOI: 10.1063/1.3632113
 13. Darin Leonhardt, Swapnadip Ghosh, and Sang M. Han, "Origin and Removal of Stacking Faults in Ge Islands Nucleated on Si within Nanoscale Openings in SiO₂," *J. Appl. Phys.*, **110**, 073516 (2011) and *Virtual Journal of Nanoscale Science & Technology* (October 24, 2011). DOI: 10.1063/1.3643003
 14. Darin Leonhardt, Josephine J. Sheng, Jeffrey G. Cederberg, Malcolm S. Carroll, Qiming Li, Manual J. Romero, Darius Kuciauskas, Daniel J. Friedman, and Sang M. Han, "Removal of Stacking Faults in Ge Grown on Si Through Nanoscale Openings in Chemical SiO₂," *Thin Solid Films*, **519**(22), 7664-7671 (2011). DOI: 10.1016/j.tsf.2011.05.044
 15. Darin Leonhardt, Josephine Sheng, Jeffrey G. Cederberg, Malcolm S. Carroll, and Sang M. Han, "Nanoscale Interfacial Engineering to Grow Ge on Si as Virtual Substrates and Subsequent Integration of GaAs," *Thin Solid Films*, **518**(21), 5920-5927 (2010). DOI: 10.1016/j.tsf.2010.05.085
 16. Jeffrey G. Cederberg, Darin Leonhardt, Josephine J. Sheng, Qiming Li, Malcolm S. Carroll, and Sang M. Han, "GaAs/Si epitaxial integration utilizing a two-step, selectively grown Ge intermediate layer," *J. Cryst. Growth*, **312**(8), 1291-1296 (2010). DOI: 10.1016/j.jcrysgro.2009.10.061
 17. Timothy J. Boyle, Louis J. Tribby, Leigh Anna M. Ottley, and Sang M. Han, "Synthesis and Characterization of Germanium(II) Coordination Compounds for the Production of Germanium Nanomaterials," *Eur. J. Inorg. Chem.*, **2009**(36), 5550-5560 (2009).
 18. Darin Leonhardt and Sang M. Han, "Energetics of Ge Nucleation on SiO₂ and Implications for Selective Epitaxial Growth," *Surf. Sci.*, **603**, 2624-2629 (2009).
 19. Youn-Jin Oh, Danny Bottenus, Cornelius F. Ivory, and Sang M. Han, "Impact of Leakage Current and Electrolysis on FET Flow Control and pH Changes in Nanofluidic Channels," *Lab on a Chip*, **9**(11), 1609-1617 (2009).
 20. Youn-Jin Oh, Anthony L. Garcia, Dimiter N. Petsev, Gabriel P. Lopez, Steven R. J. Brueck, Cornelius F. Ivory, and Sang M. Han, "Effect of wall-molecule interactions on electrokinetic transport of charged molecules in nanofluidic channels during FET flow control," *Lab on a Chip*, **9**(11), 1601-1608 (2009).
 21. Danny Bottenus, Youn-Jin Oh, Sang M. Han, and Cornelius F. Ivory, "Experimentally and Theoretically Observed Native pH Shifts in a Nanochannel Array," *Lab on a Chip*, **9**(2), 219-231 (2009). Selected as a hot LOC article.
 22. Youn-Jin Oh, Thomas C. Gamble, Darin Leonhardt, Dimiter N. Petsev, Cornelius F. Ivory, Chan-Hwa Chung, Steven R. J. Brueck, Gabriel P. Lopez, and Sang M. Han, "Monitoring FET Flow Control and Wall Adsorption of Charged Fluorescent Dye Molecules in Nanochannels Integrated into a Multiple Internal Reflection Infrared Waveguide," *Lab on a Chip*, **8**, 251-258 (2008).
 23. Timothy N. Lambert, Nicholas L. Andrews, Henry Gerung, Timothy J. Boyle, Janet M. Oliver, Bridget S. Wilson, and Sang M. Han, "Water-soluble germanium(0) nanocrystals: Cell recognition and near-infrared photothermal conversion properties," *Small*, **3**(4), 691-699 (2007).
 24. Qiming Li, Joshua L. Krauss, Stephen Hersee, and Sang M. Han, "Understanding the Interaction of Ge with Chemical and Thermal SiO₂ for Selective Growth of Ge on Si by Molecular Beam Epitaxy," *J. Phys. Chem. C*, **111**, 779-786 (2007).

25. Kyle J. Solis, Lance R. Williams, Brian S. Swartzentruber, and Sang M. Han, "Adatom Pair Chain Structures: Metastable Precursors to Island Formation on SiGe $2xN$ Alloy," *Surf. Sci.*, **601**(1), 172-177 (2006).
26. Henry Gerung, Yanrui Zhao, Ravi Jain, Timothy J. Boyle, C. Jeffrey Brinker, and Sang M. Han, "Nonlinear Optical Response of Solution Synthesized Ge Nanocrystals," *Appl. Phys. Lett.*, **89**, 111107 (2006); *Virtual Journal of Nanoscale Science & Technology*, September 25 (2006); and *Virtual Journal of Ultrafast Science*, October (2006).
27. Qiming Li and Sang M. Han, "Formation of Epitaxial Ge Nanorings on Si by Self-assembled SiO₂ Particles and Touchdown of Ge Through a Thin Layer of SiO₂," *MRS Proc.*, **921**, 0921-T02-04 (2006).
28. Henry Gerung, Timothy J. Boyle, Louis J. Tribby, Scott D. Bunge, C. Jeffrey Brinker, and Sang M. Han, "Solution Synthesis of Germanium Nanowires Using a Ge⁺² Alkoxide Precursor," *J. Am. Chem. Soc.*, **128**(15), 5244-5250 (2006).
29. Madhava Kosuri, Henry Gerung, Qiming Li, Sang M. Han, Paulo Herrera, and Jason Weaver "Vapor-Phase Adsorption Kinetics of 1-Decene on Hydrogenated Si(111)," *Surf. Sci.*, **596**, 21-38 (2005).
30. Qiming Li, Belliappa Pattada, Steve R. J. Brueck, Stephen Hersee, and Sang M. Han, "Morphological Evolution and Strain Relaxation of Ge Islands Grown on Chemically Oxidized Si(100) by Molecular Beam Epitaxy," *J. Appl. Phys.* **98**(7), 073504 (2005).
31. Qiming Li, Ying-Bing Jiang, Joshua L. Krauss, Huifang Xu, Steven R. J. Brueck, Stephen Hersee, and Sang M. Han, "Heteroepitaxy of high-quality Ge on Si by nanoscale seed pads grown through a SiO₂ interlayer," *Proc. SPIE – Int. Soc. Opt. Eng.*, **5734**, 75-82 (2005).
32. Henry Gerung, Scott D. Bunge, Timothy J. Boyle, C. Jeffrey Brinker, and Sang M. Han, "Anhydrous Solution Synthesis of High-Quality Ge Nanocrystals from the Germanium (II) Precursor Ge[N(SiMe₃)₂]₂," *Chem. Commun.*, **14**, 1914-1916 (2005).
33. Henry Gerung, C. Jeffrey Brinker, Steve R. J. Brueck, and Sang M. Han, "In situ real-time monitoring of profile evolution during plasma etching of mesoporous low-dielectric-constant SiO₂," *J. Vac. Sci. Technol. A*, **23**(2), 347 (2005).
34. Qiming Li, Ying-Bing Jiang, Huifang Xu, Steve Hersee, and Sang M. Han "Heteroepitaxy of high quality Ge on Si by nanoscale Ge seeds grown through a thin layer of SiO₂," *Appl. Phys. Lett.*, **85**(11), 1928 (2004) and *Virtual Journal of Nanoscale Science & Technology*, October 4 (2004).
35. Madhava R. Kosuri, Roya Cone, Qiming Li, Sang M. Han, Bruce C. Bunker, and Thomas M. Mayer, "Adsorption Kinetics of Alkanethiol Self-Assembly on Ge(111)," *Langmuir*, **20**(3), 835 (2004).
36. Qiming Li, Sang M. Han, Steven R. J. Brueck, Stephen Hersee, Ying-Bing Jiang, and Huifang Xu, "Selective growth of Ge on Si(100) through vias of SiO₂ nanotemplate using solid source molecular beam epitaxy," *Appl. Phys. Lett.*, **83**(24), 5032 (2003).
37. Madhava R. Kosuri, Henry Gerung, Sang M. Han, Bruce C. Bunker, and Thomas M. Mayer, "Vapor-phase Adsorption Kinetics of 1-Decene on H-terminated Si(100)," *Langmuir*, **19**(22), 9315 (2003).
38. Dhaval A. Doshi, Alain Gibaud, Valerie Goletto, Mengcheng Lu, Henry Gerung, Benjamin Ocko, Sang M. Han, and C. Jeffrey Brinker, "Peering into the self-assembly of surfactant templated thin-film silica mesophases," *J. Am. Chem. Soc.*, **125**, 11646 (2003).
39. Sang M. Han, Joseph L. Cecchi, and John J. Russell "HIGH PERFORMANCE ENGINES: FAST CARS ACCELERATE LEARNING," *Chem. Eng. Educ.* **37**(3), 208 (2003).
40. Sang M. Han, W. Robert Ashurst, Carlo Carraro, and Roya Maboudian, "Formation of Alkanethiol Monolayer on Ge(111)," *J. Am. Chem. Soc.*, **123**, 2422 (2001).
41. S. M. Han and E. S. Aydil, "Reasons for lower dielectric constant of fluorinated SiO₂ films," *J. Appl. Phys.* **83**, 2172 (1998).

42. E. Meeks, R. S. Larson, P. Ho, C. Apblett, S. M. Han, E. Edelberg, and E. Aydil, "Modeling of SiO₂ deposition in high density plasma reactors and comparisons of model predictions with experimental measurements," *J. Vac. Sci. Technol. A* **16**, 544 (1998).
43. S. M. Han and E. S. Aydil, "Structure and chemical composition of fluorinated SiO₂ films deposited using SiF₄/O₂ plasmas," *J. Vac. Sci. Technol. A* **15**, 2893 (1997).
44. S. M. Han and E. S. Aydil, "Silanol concentration depth profiling during plasma deposition of SiO₂ using multiple internal reflection infrared spectroscopy," *J. Electrochem. Soc.* **144**, 3963 (1997).
45. S. M. Han and E. S. Aydil, "Detection of combinative infrared absorption bands in thin silicon dioxide films," *Appl. Phys. Lett.* **70**, 3269 (1997).
46. S. M. Han and E. S. Aydil, "Plasma and surface diagnostics during plasma-enhanced chemical vapor deposition of SiO₂ from SiH₄/O₂/Ar discharges," *Thin Solid Films* **290 - 291**, 427 (1996).
47. S. M. Han and E. S. Aydil, "Study of surface reactions during plasma enhanced chemical vapor deposition of SiO₂ from SiH₄, O₂, and Ar," *J. Vac. Sci. Technol. A* **14**, 2062 (1996).
48. Alex P. Sassi, Anita J. Shaw, Sang M. Han, Harvey W. Blanch, and John M. Prausnitz, "Partitioning of proteins and small biomolecules in temperature- and pH-sensitive hydrogels," *Polymer*, 37(11), 2151-2164 (1996).
49. E. Meeks, R. S. Larson, P. Ho, C. Apblett, S. M. Han, E. Edelberg, and E. Aydil, "Modeling high-density-plasma deposition of SiO₂ in SiH₄/O₂/Ar." Sandia National Laboratories Report SAND97-8241 (1997).
50. E. S. Aydil and S. M. Han, "Progress in *in situ* monitoring of surfaces during plasma processing," Proceedings of the 7th International Symposium on Laser-Aided Plasma Diagnostics, Fukuoka, Japan, 172 (1995).

CONTRIBUTED/INVITED PAPERS

1. Swapnadip Gosh and Sang M. Han, "High-Carrier-Mobility p- and n-Type Field Effect Transistors Fabricated on Large-Area Wafer-Scale Ge Film Epitaxially Grown on Si," New Mexico AVS Symposium (May 21, 2013).
2. Swapnadip Gosh and Sang M. Han, "Impact of Threading Dislocation Density and Dielectric Layer on Device Characteristics of p-MESFETs Fabricated on Ge-on-Si Substrates," MRS Spring Meeting and Exhibit, San Francisco, CA (April 3, 2013).
3. Swapnadip Gosh and Sang M. Han, "Implantation-Free, High-Hole-Mobility p-MOSFETs Fabricated on Wafer-Scale Epitaxial Ge on Si," MRS Spring Meeting and Exhibit, San Francisco, CA (April 3, 2013).
4. Nicholas Shoop, Louis J. Tribby, and Sang M. Han, "Modeling of Kinetically Limited Growth Rate for Solution-Synthesized Germanium Nanocrystals," MRS Spring Meeting and Exhibit, San Francisco, CA (April 4, 2013).
5. Claire Y. Chuang, Qiming Li, Darin Leonhardt, Sang M. Han, and Talid Sinno, "Atomistic Analysis of Ge on a-SiO₂ using an Empirical Interatomic Potential to Describe Selective Epitaxial Growth," AVS 59th International Symposium and Exhibition, Tampa, FL (November 1, 2012).
6. Swapnadip Ghosh and Sang M. Han, "Impact of Threading Dislocation Density and Dielectric Layer on I-V Characteristics of Schottky Diodes Fabricated from Ti and Epitaxially Grown p-Type Ge on Si," AVS 59th International Symposium and Exhibition, Tampa, FL (November 1, 2012).
7. Josephine Sheng, David C. Chapman, David M. Wilt, Stephen J. Polly, Christopher G. Bailey, Christopher G. Kerestes, Seth M. Hubbard, and Sang M. Han, "Temperature Dependent Characterization of Imbedded InAs Quantum Dots in GaAs Superlattice Solar Cells Structures by High Resolution X-ray Diffraction," AVS 59th International Symposium and Exhibition, Tampa, FL (October 29, 2012).

8. **(Invited)** Sang M. Han, "From Nanoscale Materials Engineering to Advanced Devices Based on Germanium and Silicon," Materials Science & Technology 2012 Conference & Exhibition, Pittsburgh, PA (October 8, 2012).
9. Darin Leonhardt and Sang M. Han, "New Method to Produce High-Quality Epitaxial Ge on Si Using SiO₂-Lined Etch Pits and Epitaxial Lateral Overgrowth for III-V Integration," 221st ECS Meeting, Seattle, WA (May 9, 2012).
10. Swapnadip Gosh, Darin Leonhardt, and Sang M. Han, "Investigations on Thermal Stress Relief Mechanism Using Air-Gapped SiO₂ Nanotemplates during Epitaxial Growth of Ge on Si and Corresponding Hole Mobility Improvement," 221st ECS Meeting, Seattle, WA (May 8, 2012).
11. Josephine J. Sheng, David C. Chapman, David M. Wilt, Stephen J. Polly, Christopher G. Kerestes, Seth M. Hubbard, and Sang M. Han, "Temperature Dependent Characterization of Imbedded InAs Quantum Dots in GaAs Superlattice Solar Cells Structures by High Resolution X-ray Diffraction," Spring MRS Meeting, San Francisco, CA (April 13, 2012).
12. Swapnadip Ghosh, Darin Leonhardt, Sang M. Han, "Experimental and Theoretical Investigations Using SiO₂ Nanotemplates to Relieve Stress Caused by Thermal Expansion Coefficient Mismatch in Epitaxial Germanium on Silicon," AVS 58th International Symposium and Exhibition, Nashville, TN (November 3, 2011).
13. Darin Leonhardt and Sang M. Han, "New Method to Produce High-Quality Epitaxial Ge on Si Using SiO₂-Lined Etch Pits and Epitaxial Lateral Overgrowth for III-V Multijunction Solar Cells," AVS 58th International Symposium and Exhibition, Nashville, TN (October 31, 2011).
14. Louis Tribby, Frank van Swol, Cornelius F. Ivory, and Sang M. Han, "Transport Properties of Proteins and Quantum Dots in Nanochannels in Multi-Gated Field Effect Transistor Configuration," AVS 58th International Symposium and Exhibition, Nashville, TN (October 31, 2011).
15. **(Invited)** Sang M. Han, "Nanoscale Interfacial Engineering to Grow Ge on Si as Virtual Substrates and Subsequent Integration of GaAs," University of Texas – Austin (September 27, 2011).
16. Louis J. Tribby, Cornelius F. Ivory, Frank van Swol, and Sang M. Han, "Transport Properties of Proteins and Quantum Dots in Nanochannels in Multi-gated Field-Effect-Transistor Configuration," New Mexico AVS Symposium (May 24, 2011).
17. Darin Leonhardt and Sang M. Han, "New Method to Produce High-Quality Epitaxial Ge on Si Using SiO₂-Lined Etch Pits and Epitaxial Lateral Overgrowth for III-V Multijunction Solar Cells," New Mexico AVS Symposium (May 24, 2011).
18. Swapnadip Ghosh, Darin Leonhardt, and Sang M. Han, "Experimental and Theoretical Investigations Using SiO₂ Nanotemplates to Relieve Stress Caused by Thermal Expansion Coefficient Mismatch in Epitaxial Germanium Grown on Silicon," New Mexico AVS Symposium (May 24, 2011).
19. Josephine J. Sheng, Darin Leonhardt, Jeffery G. Cederberg, Malcolm S. Carroll, Qiming Li, Manuel K. Romero, Steve Johnston, and Sang M. Han, "Minority Carrier Lifetime in Epitaxially Grown Ge Film on Si by Nanoscale Interfacial Engineering," New Mexico AVS Symposium (May 24, 2011).
20. Louis J. Tribby, Cornelius F. Ivory, Frank van Swol, and Sang M. Han, "Experimental and Theoretical Comparison of Aspect-ratio-dependent Diffusion of CdSe Nanocrystals through Nanochannels," Spring MRS Meeting, San Francisco, CA (April 28, 2011).
21. Josephine J. Sheng, Darin Leonhardt, Jeffery G. Cederberg, Malcolm S. Carroll, Qiming Li, Manuel J. Romero, Steve Johnston, and Sang M. Han, "Minority Carrier Lifetime in Ge Film Epitaxially Grown on Si by Nanoscale Interfacial Engineering," Spring MRS Meeting, San Francisco, CA (April 28, 2011).
22. Louis J. Tribby, Cornelius F. Ivory, Frank van Swol, and Sang M. Han, "Transport Properties of Proteins and Quantum Dots in Nanochannels in Multi-gated Field-Effect-Transistor Configuration," Spring MRS Meeting, San Francisco, CA (April 27, 2011).

23. Swapnadip Ghosh, Darin Leonhardt, and Sang M. Han, "Use of SiO₂ Templates for Relieving thermally Induced Stress During Epitaxial Growth of Ge on Si for III-V Photovoltaic Applications," Spring MRS Meeting, San Francisco, CA (April 26, 2011).
24. (*Invited*) Sang M. Han, "Nanoscale Interfacial Engineering to Grow Ge on Si as Virtual Substrates and Subsequent Integration of GaAs," Stanford University (March 7, 2011).
25. Josephine J. Sheng, Darin Leonhardt, Jeffrey G. Cederberg, Malcolm Carroll, Manuel J. Romero, Steve Johnston, and Sang M. Han, "Characterization of Minority Carrier Lifetime in Ge Films Epitaxially Grown on Si by Nanoscale Interfacial Engineering," AVS 57th International Symposium and Exhibition, Albuquerque, NM (October 21, 2010).
26. Darin Leonhardt, Josephine J. Sheng, Jeffrey G. Cederberg, Malcolm Carroll, Manuel J. Romero, and Sang M. Han, "Growing Low-Dislocation-Density Ge on Si Through Nanometer Sized Voids in Chemical Oxide and Subsequent Integration of III-V Films for Multijunction Solar Cells," AVS 57th International Symposium and Exhibition, Albuquerque, NM (October 19, 2010).
27. Josephine Sheng, Darin Leonhardt, Malcolm S. Carroll, Jeffrey G. Cederberg, and Sang M. Han, "Characterization of Carrier Lifetime in Ge Films Epitaxially Grown on Si by Nanoscale Heterojunction Engineering," Spring MRS Meeting, San Francisco, CA (April 7, 2010).
28. Louis L. Tribby, Cornelius F. Ivory, Frank van Swol, and Sang M. Han, "Experimental and Theoretical Comparison of Aspect-Ratio-Dependent Diffusion of CdSe Nanocrystals Through Nanochannels," Spring MRS Meeting, San Francisco, CA (April 7, 2010).
29. Darin Leonhardt, Josephine J. Sheng, Jeffrey G. Cederberg, Malcolm S. Carroll, Manuel J. Romero, and Sang M. Han, "Study of Surface Reactions and Defect Reduction by Scalable Ge-on-Si Nanoscale Heterojunction Engineering and GaAs Integration for III-V Photovoltaics," Spring MRS Meeting, San Francisco, CA (April 6, 2010).
30. Josephine Sheng, Darin Leonhardt, Jeffrey G. Cederberg, Malcolm S. Carroll, and Sang M. Han, "Lifetime and defect characterization of engineered germanium-on-silicon wafers for III-V photovoltaics," AVS 56th International Symposium and Exhibition, San Jose, CA (November 10, 2009).
31. Darin Leonhardt, Josephine Sheng, Jeffrey G. Cederberg, Malcolm S. Carroll, and Sang M. Han, GaAs Integration on High-Quality Ge on Si for Multijunction Solar Cells," AVS 56th International Symposium and Exhibition, San Jose, CA (November 10, 2009).
32. Louis L. Tribby, Cornelius F. Ivory, Frank van Swol, and Sang M. Han, "Experimental and theoretical comparison of aspect-ratio-dependent diffusion of CdSe nanocrystals through nanochannels," Annual AIChE Meeting, Nashville, TN (November 10, 2009).
33. Darin Leonhardt, Josephine Sheng, Jeffrey G. Cederberg, Malcolm S. Carroll, and Sang M. Han, "GaAs Integration on High-Quality Ge on Si for Multijunction Solar Cells," Annual AIChE Meeting, Nashville, TN (November 9, 2009).
34. Jeffrey G. Cederberg, Darrell L. Alliman, Darin Leonhardt, Josephine J. Sheng, Qiming Li, Karen Cross, Malcolm S. Carroll, and Sang M. Han, "Epitaxial integration of GaAs on Si using strain-relaxed Ge intermediate layer – challenges and progress," The 17th American Conference on Crystal Growth and Epitaxy, Lake Geneva, WI (August 9 – 14, 2009).
35. Josephine Sheng, Darin Leonhardt, Jeffrey G. Cederberg, Malcolm S. Carroll, and Sang M. Han, "Slurry-Free Chemical Mechanical Planarization of Engineered Ge-on-Si Wafers for GaAs Integration," Spring MRS Meeting, San Francisco, CA (April 15, 2009).
36. Younjin Oh, Danny Bottenus, Cornelius F. Ivory, and Sang M. Han, "High-Resolution Protein Separations in a Nanofluidic FET Device, using pH and Potential Gradient," Spring MRS Meeting, San Francisco, CA (April 14, 2009).
37. Darin Leonhardt, Josephine Sheng, Thomas E. Vandervelde, Jeffrey G. Cederberg, Malcolm S. Carroll, and Sang M. Han, "Nanoscale Heterojunction Engineering to Grow High-Quality Ge on Si and Subsequent GaAs Integration for Multijunction Solar Cells," Spring MRS Meeting, San Francisco, CA (April 14, 2009).

38. Darin Leonhardt, Josephine Sheng, Thomas Vandervelde, Jeffrey Cederberg, Malcolm Carroll, Sang M. Han, "Nanoscale Heterojunction Engineering to Grow High-Quality Ge on Si for Multijunction Solar Cells," Annual AIChE Meeting, Philadelphia, PA (November 20, 2008).
39. Youn-Jin Oh, Danny Bottenus, Cornelius F. Ivory, and Sang M. Han, "Field Effect Transistor Flow Control and Separation of Proteins in Nanofluidic Devices," Annual AIChE Meeting, Philadelphia, PA (November 20, 2008).
40. Danny Bottenus, Youn-Jin Oh, Sang M. Han, and Cornelius F. Ivory, "Experimentally and Theoretically Observed Native pH Shifts in a Nanochannel Array," Annual AIChE Meeting, Philadelphia, PA (November 18, 2008).
41. **(Invited)** Youn-Jin Oh, Danny Bottenus, Thomas C. Gamble, Anthony Garcia, Dimiter N. Petsev, Cornelius F. Ivory, Steven R. J. Brueck, Gabriel P. Lopez, and Sang M. Han*, "Control and Separation of Proteins in a Nanofluidic FET Device, using pH Gradient and Valence Charge," Annual AIChE Meeting, Philadelphia, PA (November 18, 2008).
42. Youn-Jin Oh, Danny Bottenus, Cornelius F. Ivory, and Sang M. Han, "Control and Separation of Proteins in a Nanofluidic FET Device, using pH Gradient and Valence Charge," AVS 55th International Symposium and Exhibition, Boston, MA (October 23, 2008).
43. Darin Leonhardt, Josephine Sheng, Thomas E. Vandervelde, Jeffrey G. Cederberg, Malcolm S. Carroll, and Sang M. Han, "Nanoscale Heterojunction Engineering to Grow High-Quality Ge on Si for Multijunction Solar Cells," AVS 55th International Symposium and Exhibition, Boston, MA (October 21, 2008).
44. M. Carroll, E. Nordberg, K. Eng, D. Kluskiewicz, G. Ten Eyck, K. Childs, J. Wendt, J. Stevens, T. Lemp, J. Sheng, J. Grey, S. Han, M. Lilly, and M. Eriksson, "Si and SiGe based double top gated accumulation mode single electron transistors for quantum bits," Electrochemical Society Pacific Rim Meeting on Electrochemical and Solid State Science, Honolulu, HI (October 13, 2008).
45. Qiming Li, Darin Leonhardt, Josephine Sheng, Thomas E. Vandervelde, Jeffrey G. Cederberg, Malcolm S. Carroll, and Sang M. Han, "Nanoscale Heterojunction Engineering to Grow High-Quality Ge on Si for Multijunction Solar Cells," 44th New Mexico AVS Symposium (May 20, 2008).
46. **(Invited)** Sang M. Han, "Nanoscale Heterojunction Engineering and Understanding of Surface Phenomena Responsible for the Selective Growth of Ge on Si over SiO₂ During Molecular Beam Epitaxy," Auburn University (April 9, 2007).
47. Youn-Jin Oh, Danny Bottenus, Cornelius F. Ivory, and Sang M. Han, "Isoelectric Focusing and Separation of Proteins by pH and Potential Gradient in a Nanofluidic Field Effect Transistor Device," Spring MRS Meeting, San Francisco, CA (March 27, 2008).
48. Darin Leonhardt and Sang M. Han, "Probing Effect of Interaction and Thermal Expansion Mismatch between Ge and Templated Mask on Defects during Selective Molecular Beam Epitaxy of Ge on Si," Spring MRS Meeting, San Francisco, CA (March 27, 2008).
49. Louis J. Tribby, Youn-Jin Oh, Timothy J. Boyle, and Sang M. Han, "Probing Differential Ligand Surface Passivation on Nanowire by Electric-Field-Induced Alignment in Nanochannels Integrated into a Multiple Internal Reflection Infrared Waveguide," Spring MRS Meeting, San Francisco, CA (March 26, 2008).
50. **(Invited)** Sang M. Han, "Nanoscale Heterojunction Engineering and Selective Growth of High-Quality Ge on Si by Molecular Beam Epitaxy," Annual TMS Meeting, New Orleans, LA (March 11, 2008).
51. Youn-Jin Oh, Danny Bottenus, Dimiter N. Petsev, Cornelius F. Ivory, Steven R. J. Brueck, Gabriel P. Lopez, Sang M. Han, "Study of FET Flow Control and Separation of Proteins in Nanofluidic Channels," 54th International American Vacuum Society Symposium, Seattle, WA (October 17, 2007).
52. Qiming Li, Darin Leonhardt, and Sang M. Han, "Probing the Effect of Ge Island Coalescence over a Templated Mask on Defect Formation during Selective Molecular Beam Epitaxy of Ge on Si," 54th International American Vacuum Society Symposium, Seattle, WA (October 17, 2007).

53. Qiming Li, Darin Leonhardt, Keith Gallow, and Sang M. Han, "Dislocation Density Reduction in Ge Epilayers on Si by Low-Temperature Deposition and Insulator-Capped Post-Growth Annealing for Subsequent Integration of III-V on Ge/Si," 25th North American Conference on Molecular Beam Epitaxy, Albuquerque, NM (September 26, 2007).
54. **(Invited)** Sang M. Han, "Nanoscale Heterojunction Engineering and Understanding of Surface Phenomena Responsible for the Selective Growth of Ge on Si over SiO₂ During Molecular Beam Epitaxy," University of Pennsylvania (September 26, 2007).
55. M. Jeong, C. Chung, N. Kulyk, Y. Oh, S. Han, S. Baek, J. Kang and S. Ham, "Separation of Nanoparticles in Nanochannels Using Electroosmotic Force," the 212th Meeting of the Electrochemical Society, Washington DC (October 2007).
56. Qiming Li, Keith Gallow, Darin Leonhardt, and Sang M. Han, "Dislocation Density Reduction in Ge Epilayers on Si by Low-Temperature Deposition and Insulator-Capped Post-Growth Annealing," 43rd Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 22, 2007).
57. Darin Leonhardt, Qiming Li, and Sang M. Han, "Effect of Interdistance of Nanoscale Windows in W Templates on Coalescence and Defect Density during Selective Molecular Beam Epitaxy of Ge on Si," 43rd Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 22, 2007).
58. Louis J. Tribby, Youn-Jin Oh, Timothy J. Boyle, Timothy N. Lambert, and Sang M. Han, "Nanofluidic Size Focusing of Functionalized CdSe Quantum Dots," 43rd Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 22, 2007).
59. Youn-Jin Oh, Danny Bottenus, Dimiter N. Petsev, Cornelius F. Ivory, Steven R. J. Brueck, Gabriel P. Lopez, and Sang M. Han, "Study of Field Effect Transistor Flow Control of Proteins and pH Changes in Nanochannels," 43rd Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 21, 2007).
60. **(Invited)** Gabriel P. Lopez, Steven R. J. Brueck, Sang M. Han, Cornelius F. Ivory, Dimiter N. Petsev, and Scott S. Sibbett, "Materials Processing Methods and Issues in the Development of Nanofluidic Systems for Biomolecular Analysis," Spring MRS Meeting, San Francisco, CA (April 12, 2007).
61. Timothy N. Lambert, Nicholas L. Andrews, Bernadette A. Hernandez-Sanchez, Henry Gerung, Timothy J. Boyle, Paul Rotella, Janet M. Oliver, Sang M. Han, Bridget S. Wilson, and Sanjay Krishna, "Near-Infrared Photothermal Conversion Properties and Cell Recognition of Biocompatible Germanium(0) Nanocrystals," Spring MRS Meeting, San Francisco, CA (April 10, 2007).
62. Louis J. Tribby, Youn-Jin Oh, Timothy N. Lambert, Timothy J. Boyle, and Sang M. Han, "Nanofluidic Size Focusing of Charge Functionalized CdSe Quantum Dots," Spring MRS Meeting, San Francisco, CA (April 10, 2007).
63. Youn-Jin Oh, Danny Bottenus, Yi Zhang, Dimiter N. Petsev, Cornelius F. Ivory, Steven R. J. Brueck, Gabriel P. Lopez, and Sang M. Han, "Study of FET Flow Control of Proteins and pH Changes in Nanochannels Using Scanning Laser Confocal Fluorescence Microscopy and Multiple Internal Reflection Fourier Transform Infrared Spectroscopy," Spring MRS Meeting, San Francisco, CA (April 12, 2007).
64. Qiming Li Darin Leonhardt, Keith Gallow, and Sang M. Han, "Dislocation Density Reduction in Ge Epilayers on Si by Low-Temperature Deposition and Insulator-Capped Post-Growth Annealing and Subsequent Integration of III-V on Ge/Si," Spring MRS Meeting, San Francisco, CA (April 12, 2007).
65. Darin Leonhardt, Qiming Li, and Sang M. Han, "Effect of Interdistance of Nanoscale Windows in W Templates on Coalescence and Defect Density During Selective Molecular Beam Epitaxy of Ge on Si," Spring MRS Meeting, San Francisco, CA (April 12, 2007).
66. Qiming Li, Joshua L. Krauss, Stephen Hersee, and Sang M. Han, "Probing Interactions of Ge with Chemical and Thermal SiO₂ to Understand Selective Growth of Ge on Si during Molecular Beam Epitaxy," AVS 53rd International Symposium & Exhibition and Annual AIChE Meeting (2006).
67. Henry Gerung, Louis J. Tribby, Timothy N. Lambert, Nicholas Andrews, Timothy J. Boyle, C. Jeffrey Brinker, Janet M. Oliver, and Sang M. Han, "Germanium Nanocrystals and Nanowires: Morphological

- Control, Surface Characterization, and Applications,” AVS 53rd International Symposium & Exhibition and Annual AIChE Meeting (2006).
68. Youn-Jin Oh, Dimiter N. Petsev, Cornelius F. Ivory, Chan-Hwa Chung, Steven R. J. Brueck, Gabriel P. Lopez, Sang M. Han, “Study of FET Flow Control and Electrostatic Response of Charged Molecules in Nanofluidic Channels,” AVS 53rd International Symposium & Exhibition and Annual AIChE Meeting (2006).
 69. Qiming Li, Darin Leonhardt, Joshua L. Krauss, Stephen Hersee, and Sang M. Han, “Selective Molecular Beam Epitaxy of High-Quality Ge on Si Covered with SiO₂,” European Materials Research Society 2006 Spring Meeting, Nice, France (May 29, 2006).
 70. Youn-Jin Oh, Dimiter N. Petsev, Cornelius F. Ivory, Chan-Hwa Chung, Steve R. J. Brueck, Gabriel P. Lopez, and Sang M. Han, “Study of Molecular Transport in Nanofluidic Channels by Integrated Multiple Internal Reflection Infrared Waveguide,” 42nd Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 22, 2006).
 71. Qiming Li, Joshua L. Krauss, Stephen Hersee, and Sang M. Han, “Probing Interactions of Ge with Chemical and Thermal SiO₂ to Understand Selective Growth of Ge on Si during Molecular Beam Epitaxy,” 42nd Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 23, 2006).
 72. Keith Gallow, Sang M. Han, and Qiming Li, “Growth of Vertically Aligned Diamond Nanorods,” 42nd Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 23, 2006).
 73. (*Invited*) Sang M. Han, “Understanding of Surface Phenomena Responsible for the Selective Growth of Ge on Si over SiO₂ During Molecular Beam Epitaxy,” University of California – Riverside, CA (April 21, 2006).
 74. Louis Tribby, Henry Gerung, Timothy J. Boyle, and Sang M. Han, “Sterically Varied Germanium Alkoxides/Silanols/Thiols for Solution Synthesis of Nanocrystals and Nanowires,” Spring MRS Meeting, San Francisco, CA (April 20, 2006).
 75. Younjin Oh, Thomas C. Gamble, Anthony Garcia, Alexander Neumann, Chan-Hwa Chung, Dimiter N. Petsev, Cornelius F. Ivory, Steven R. J. Brueck, and Sang M. Han, “Study of Molecular Transport in Nanofluidic Channels by Integrated Multiple Internal Reflection Infrared Waveguide,” Spring MRS Meeting, San Francisco, CA (April 19, 2006).
 76. Steve Hersee, Sang Han, Xinyu Sun, and Xin Wang, “Nanoheteroepitaxy for Efficient GaN LEDs on Silicon,” Spring MRS Meeting, San Francisco, CA (April 19, 2006).
 77. Qiming Li and Sang M. Han, “Formation of Epitaxial Ge Nanorings on Si by Self-assembled SiO₂ Particles and Touchdown of Ge Through a Thin Layer of SiO₂,” Spring MRS Meeting, San Francisco, CA (April 18, 2006).
 78. (*Invited*) Sang M. Han, “Understanding of Surface Phenomena Responsible for the Selective Growth of Ge on Si over SiO₂ During Molecular Beam Epitaxy,” Colorado School of Mines, Golden, CO (February 3, 2006).
 79. Qiming Li and Sang M. Han, “Formation of Epitaxial Ge Nanorings on Si by Self-assembled SiO₂ Particles and Touchdown of Ge Through a Thin Layer of SiO₂,” AVS 52nd International Symposium & Exhibition and Annual AIChE Meeting (2005).
 80. Thomas C. Gamble, Youn-Jin Oh, Anthony Garcia, Alexander Neumann, Dimiter N. Petsev, Cornelius F. Ivory, Chan-Hwa Chung, Steven R. J. Brueck, Gabriel P. Lopez, and Sang M. Han, “Study of Molecular Transport in Nanofluidic Channels by Integrated Multiple Internal Reflection Infrared Waveguide,” AVS 52nd International Symposium & Exhibition and Annual AIChE Meeting (2005).
 81. Henry Gerung, Timothy N. Lambert, Timothy J. Boyle, Louis J. Tribby, Nicholas Andrews, Janet M. Oliver, C. Jeffrey Brinker, and Sang M. Han, “Control of Germanium Nanocrystal Morphology and Surface Functionalization,” AVS 52nd International Symposium & Exhibition and Annual AIChE Meeting (2005).
 82. Kyle J. Solis, Lance R. Williams, Brian S. Swartzentruber, and Sang M. Han, “Adatom-Pair Chain Structures: Metastable Precursors to Island Formation on the Ge-Si(100) 2xN Alloyed Surface,” AVS 52nd International Symposium & Exhibition and Annual AIChE Meeting (2005).

83. Madhava R. Kosuri, Henry Gerung, Qiming Li, Sang M. Han, Paulo E. Herrera-Morales, and Jason F. Weaver, "Mechanism and Kinetics of Alky Monolayer Formation on Hydrogenated Si(111)," Annual AIChE Meeting, Cincinnati, OH (October 31, 2005)
84. Henry Gerung, Louis J. Tribby, Timothy J. Boyle, C. Jeffrey Brinker, and Sang M. Han, "Germanium Nanocrystal and Nanowire Synthesis Via Molecularly Designed Ge⁺² Precursors," 17th Annual Rio Grande Symposium on Advanced Materials, Albuquerque, NM (October 11, 2005).
85. **(Invited)** Sang M. Han, "Understanding of Surface Phenomena Responsible for the Selective Growth of Ge on Si over SiO₂ During Molecular Beam Epitaxy," Washington State University, Pullman, WA (October 10, 2005).
86. **(Invited)** Sang M. Han, "*In Situ* Real-Time Monitoring of Evaporation Induced Self-Assembly of Mesoporous Low-Dielectric Constant SiO₂ and Its Profile Evolution During Plasma Etching," Northern California Chapter of the American Vacuum Society PEUG/TFUG Annual Symposium, San Jose, CA (October 2005).
87. **(Invited)** Sang M. Han, "Understanding of Surface Phenomena Responsible for the Selective Growth of Ge on Si over SiO₂ During Molecular Beam Epitaxy," Rensselaer Polytechnic Institute (September 2005).
88. Henry Gerung, Scott D. Bunge, Timothy J. Boyle, C. Jeffrey Brinker, and Sang M. Han, "Control of Germanium Nanocrystal Morphology via Precursor Modification," 41st Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 24, 2005).
89. Qiming Li and Sang M. Han, "Formation of Epitaxial Ge Nanorings on Si by Self-Assembled SiO₂ Particles and Touchdown of Ge Through a Thin Layer of SiO₂," 41st Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 24, 2005).
90. Thomas C. Gamble, Youn-Jin Oh, Dimieter N. Petsev, Cornelius F. Ivory, Chan-Hwa Chung, Steven R. J. Brueck, Gabriel P. Lopez, and Sang M. Han, "Study of Molecular Transport in Nanofluidic Channels by Integrated Multiple Internal Reflection Infrared Waveguide," 41st Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 23, 2005).
91. Kyle J. Solis, Lance R. Williams, Brian S. Swartzentruber, and Sang M. Han, "Adatom-Pair Chain Structures: Metastable Precursors to Island Formation on the Ge-Si(100) 2xN Alloyed Surface," 41st Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 23, 2005).
92. Stephen Hersee, Sang M. Han, Xin Yu Sun, Xin Wang, and Qiming Li, "Nanoheteroepitaxy: The Use of Compliant Nanostructures to Accommodate Large Lattice Mismatch in Semiconductor Heterostructures," The 11th European Workshop on Metalorganic Vapor Phase Epitaxy, Lausanne, Switzerland (June 5th-8th, 2005).
93. Qiming Li, Joshua L. Krauss, Stephen Hersee, and Sang M. Han, "Understanding of Surface Phenomena Responsible for the Selective Growth of Ge on Si over SiO₂ During Molecular Beam Epitaxy," Spring MRS Meeting, San Francisco, CA (March 30, 2005).
94. Henry Gerung, Scott D. Bunge, Timothy J. Boyle, C. Jeffrey Brinker, and Sang M. Han, "Synthesis of Germanium Nanocrystals and Nanowires via Ge(II) Precursors," Spring MRS Meeting, San Francisco, CA (March 31, 2005).
95. **(Invited)** Sang M. Han, "Micro to Atomic Scale Interfacial Science and Engineering on Si and Ge Based Systems," University of Massachusetts – Amherst, MA (March 1, 2005).
96. **(Invited)** Sang M. Han, "Molecular beam epitaxy of high-quality Ge on Si by self-directed "touchdown" of nanoscale seed pads through a thin SiO₂," SPIE Photonics West 2005, San Jose, CA (January 24, 2005).
97. Henry Gerung, Scott D. Bunge, Timothy J. Boyle, C. Jeffrey Brinker, and Sang M. Han, "Synthesis and Characterization of Germanium Nanocrystals and Nanowires," 2004 AVS International Symposium, Anaheim, CA (November 16, 2004).
98. Qiming Li, Darin Leonhardt, Ying-Bing Jiang, Huifang Xu, Steven R. J. Brueck, Stephen Hersee, and Sang M. Han, "MBE of High-Quality Ge on Si by "Touchdown" of Nanoscale Ge Seeds," 2004 AVS International Symposium, Anaheim, CA (November 16, 2004).

99. Madhava Kosuri, Henry Gerung, Qiming Li, Sang M. Han, Paulo Herrera, and Jason Weaver, "Vapor-Phase Adsorption Kinetics of 1-Decene on Hydrogenated Si(111)," 2004 AVS International Symposium, Anaheim, CA (November 16, 2004).
100. Qiming Li, Darin Leonhardt, Ying-Bing Jiang, Huifang Xu, Stephen Hersee, and Sang M. Han, "MBE of High-Quality Ge on Si by "Touchdown" of Nanoscale Ge Seeds," AICHE 2004 Annual Meeting, Austin, TX (November 11, 2004).
101. Madhava Kosuri, Henry Gerung, Qiming Li, Sang M. Han, Paulo Herrera, and Jason Weaver, "Vapor-Phase Adsorption Kinetics of 1-Decene on Hydrogenated Si(111)," AICHE 2004 Annual Meeting, Austin, TX (November 9, 2004).
102. *(Invited)* Sang M. Han, "Micro to Atomic Scale Surface Science and Engineering on Si and Ge Based Systems," Los Alamos National Laboratory (June 28, 2004).
103. Madhava R. Kosuri, Roya Cone, Qiming Li, Bruce C. Bunker, Thomas M. Mayer, and Sang M. Han, "Liquid-Phase Self-Assembly of 1-Alkanethiols and 11-Mercapto-1-Undecanols on Hydrogenated Ge(111)," 40th Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 18, 2004).
104. Kyle J. Solis, Brian S. Swartzentruber, and Sang M. Han, "Strain-Mediated Formation of Adatom-Pair Structures in the Ge/Si(100) Heterosystem," 40th Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 18, 2004).
105. Qiming Li, Darin Leonhardt, Ying-Bing Jiang, Huifang Xu, Steven R. J. Brueck, Stephen Hersee, and Sang M. Han, "Molecular Beam Epitaxy of High-Quality Ge on Si by Self-directed "Touchdown" of Nanoscale Seed Pads," 40th Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 17, 2004).
106. Henry Gerung, Scott D. Bunge, Timothy J. Boyle, C. Jeffrey Brinker, and Sang M. Han, "Synthesis and Characterization of Germanium Nanocrystals," 40th Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 17, 2004).
107. *(Invited)* Sang M. Han, "Micro to Atomic Scale Surface Science and Engineering on Si and Ge Based Systems," University of Florida, Gainesville, FL (April 19, 2004).
108. Qiming Li, Darin Leonhardt, Ying-Bing Jiang, Huifang Xu, Steven R. J. Brueck, Stephen Hersee, and Sang M. Han (speaker), "MBE of high-quality Ge on Si through vias of SiO₂ nanotemplate and by self-directed "touchdown" of nanoscale seed pads," Materials Research Society 2004 Spring Meeting, San Francisco (April 15, 2004).
109. *(Invited)* Sang M. Han, "Micro to Atomic Scale Surface Science and Engineering on Si and Ge Based Systems," University of California Santa Barbara, Santa Barbara, CA (April 1, 2004).
110. *(Invited)* Sang M. Han, "Micro to Atomic Scale Surface Science and Engineering on Si and Ge Based Systems," University of California Los Angeles, Los Angeles, CA (February 27, 2004).
111. *(Invited)* Sang M. Han, "Micro to Atomic Scale Surface Science and Engineering on Si and Ge Based Systems," Sandia National Laboratories, Albuquerque, NM (February 12, 2004).
112. *(Invited)* Sang M. Han, "Micro to Atomic Scale Surface Science and Engineering on Si and Ge Based Systems," Center for High Technology Materials, University of New Mexico, Albuquerque, NM (February 6, 2004).
113. *(Invited)* Sang M. Han, "Micro to Atomic Scale Surface Science and Engineering on Si and Ge Based Systems," Drexel University, Philadelphia, PA (November 24, 2003).
114. *(Invited)* Sang M. Han, "Micro to Atomic Scale Surface Science and Engineering on Si and Ge Based Systems," Lam Research Corporation, Fremont, CA (November 20, 2003).
115. Madhava R. Kosuri, Henry Gerung, Qiming Li, Sang M. Han (speaker), "Vapor-phase Adsorption Kinetics of 1-Decene on H-terminated Si(100)," AICHE 2003 Annual Meeting, San Francisco (November 19, 2003).

116. Henry Gerung, C. Jeffrey Brinker, Steve R. J. Brueck, and Sang M. Han (speaker), "In Situ Real Time Monitoring of Profile Evolution During Plasma Etching," AICHE 2003 Annual Meeting, San Francisco (November 18, 2003).
117. Sang M. Han, "Tips for Preparing for NSF CAREER," AICHE 2003 Annual Meeting, San Francisco (November 17, 2003).
118. Henry Gerung, C. Jeffrey Brinker, Steve R. J. Brueck, and Sang M. Han, "In Situ Real Time Monitoring of Profile Evolution During Plasma Etching," AVS 50th International Symposium, Baltimore, MD (November 6, 2003).
119. Madhava R. Kosuri (poster presenter), Roya Cone, Qiming Li, Sang M. Han, Bruce C. Bunker, and Thomas M. Mayer, "Adsorption Kinetics of Alkanethiol Self-Assembly on Hydrogenated Ge(111)," AVS 50th International Symposium, Baltimore, MD (November 5, 2003).
120. Madhava R. Kosuri, Henry Gerung, Qiming Li, Sang M. Han (speaker), Bruce C. Bunker, and Thomas M. Mayer, "Vapor-phase Adsorption Kinetics of 1-Decene on H-Terminated Si(100)," AVS 50th International Symposium, Baltimore, MD (November 4, 2003).
121. (*Invited*) Sang M. Han, "Micro to Atomic Scale Surface Science and Engineering on Si and Ge Based Systems," Seoul National University, Seoul, Korea (May 15, 2003).
122. (*Invited*) Sang M. Han, "Micro to Atomic Scale Surface Science and Engineering on Si and Ge Based Systems," Seung-Kyun-Kwan University, Suwon, Korea (May 14, 2003).
123. Qiming Li and Sang M. Han, "Characterization of Ionic Species in SiH₄/Ar ECR Plasma and Role of Ions on Si Film Deposition," 39th Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (April 30, 2003).
124. Henry Gerung, Jeffrey C. Brinker, Steven R. J. Brueck, and Sang M. Han, "In-situ Real-time Monitoring of Profile Evolution During Plasma Etching," 39th Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (April 30, 2003).
125. Madhava R. Kosuri, Henry Gerung, Qiming Li, Sang M. Han, Bruce C. Bunker and Thomas M. Mayer, "Vapor-phase Adsorption Kinetics of 1-Decene on H-terminated Si(100)," 39th Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (April 29, 2003).
126. Henry Gerung, Dhaval Doshi, C. Jeffrey Brinker, and Sang M. Han (*speaker*), "In Situ Real Time Monitoring of Low-k Mesoporous SiO₂ During Evaporation Induced Self-Assembly and Plasma Etching," AICHE 2002 Annual Meeting, Indianapolis, IN (November 8, 2002).
127. Henry Gerung, Dhaval Doshi, C. Jeffrey Brinker, and Sang M. Han (*speaker*), "In Situ Real Time Monitoring of Low-k Mesoporous SiO₂ During Evaporation Induced Self-Assembly and Plasma Etching," AVS 49th International Symposium, Denver, CO (November 7, 2002).
128. Sang M. Han, "HIGH PERFORMANCE ENGINES: FAST CARS ACCELERATE LEARNING," ASEE Summer School for Chemical Engineering Faculty Poster Competition and Winner, Boulder, CO (July 27 – August 2, 2002).
129. Henry Gerung, C. Jeffrey Brinker, and Sang M. Han (speaker), "In Situ Real Time Monitoring of Low-k Mesoporous SiO₂ During Evaporation Induced Self-Assembly and Plasma Etching," 38th Annual New Mexico American Vacuum Society Symposium, Albuquerque, NM (May 15, 2002).
130. Sang M. Han, "In Situ Real Time Investigation of High-Aspect-Ratio Porous Solgel Silica Features During Plasma Etching," Center for Micro-Engineered Materials (CMEM) Annual Industrial Advisory Board (IAB) Meeting, Albuquerque, NM (March 20, 2002).
131. (*Invited*) Sang M. Han, "Fundamental Plasma Physics and Chemistry to Real Life Plasma Tools," Intel Annual Lecture Series, Intel Corporation, Rio Rancho, NM (November 27, 2001).
132. Sang M. Han, "Research Direction and Topics: In Situ Real Time Monitoring of Interfacial Phenomena," Center for Micro-Engineered Materials (CMEM) Annual Industrial Advisory Board (IAB) Meeting, Albuquerque, NM (February 27, 2001).

133. Sang M. Han (speaker) and Eray S. Aydil, "Effects of Feed Gas Composition on Impurity Concentration, Structure, and Dielectric Constant of Fluorinated SiO₂ Films Deposited from SiF₄/SiH₄/O₂/Ar Plasmas," Emerging Technologies 2000, American Vacuum Society – New Mexico Chapter, Albuquerque, NM (May 25, 2000).
134. *(Invited)* Sang M. Han, "Plasma enhanced chemical vapor deposition of SiO₂ and fluorinated SiO₂ films," University of New Mexico, Albuquerque, NM (February 4, 1999).
135. *(Invited)* Sang M. Han, "Plasma enhanced chemical vapor deposition of SiO₂ and fluorinated SiO₂ films," Reunión de Invierno "New Horizons in Materials Science" sponsored by Universidad Nacional Autónoma de México, Querétaro, Mexico (January 18, 1999).
136. *(Invited)* Sang M. Han, "Plasma enhanced chemical vapor deposition of SiO₂ and fluorinated SiO₂ films," National Institute of Standards and Technology, Gaithersburg, MD (March 27, 1998).
137. *(Invited)* Sang M. Han, "Plasma enhanced chemical vapor deposition of SiO₂ and fluorinated SiO₂ films," Lucent Technologies – Bell Labs, Murray Hill, NJ (March 26, 1998).
138. *(Invited)* Sang M. Han, "Plasma enhanced chemical vapor deposition of SiO₂ and fluorinated SiO₂ films," Stanford University, Stanford, CA (February 4, 1998).
139. Sang M. Han (speaker) and Eray S. Aydil, "Plasma enhanced chemical vapor deposition of fluorinated silicon dioxide films," AIChE Annual Meeting, Los Angeles, CA (November 1997).
140. S. M. Han (speaker) and E. S. Aydil, "Structure and chemical composition of fluorinated SiO₂ films deposited using SiF₄/O₂ and SiF₄/SiH₄/O₂ plasmas," 44th National Symposium of the American Vacuum Society, San Jose, CA (October 1997).
141. R. S. Larson, E. Meeks, P. Ho, C. Apblett, S. M. Han, E. A. Edelberg, and E. S. Aydil, "Modeling of silicon dioxide deposition in high density plasma reactors and comparison of model predictions with experimental measurements," 44th National Symposium of the American Vacuum Society, San Jose, CA (October 1997).
142. S. M. Han (speaker) and E. S. Aydil, "Structure and chemical composition of fluorinated SiO₂ films deposited using SiF₄/O₂ and SiF₄/SiH₄/O₂ plasmas," 30th Annual Southern California Chapter American Vacuum Society Symposium, Anaheim, CA (September 1997).
143. C. Sone, E. Yoon, S. M. Han, and E. S. Aydil, "Optical emission spectroscopy study on the low temperature growth of GaN by remote plasma enhanced chemical vapor deposition," Joint International Meetings of the Electrochemical Society (192nd) and the International Society of Electrochemistry (48th), Symposium on Compound Semiconductors III-V Nitride Materials and Processes, Paris, France (September 1997).
144. E. S. Aydil and S. M. Han, "Plasma enhanced chemical vapor deposition of silicon dioxide: factors controlling the silanol incorporation," AIChE Annual Meeting, Chicago, IL (November 1996).
145. *(Invited)* S. M. Han (speaker) and E. S. Aydil, "Gas phase and surface diagnostics during plasma enhanced chemical vapor deposition of SiO₂ through SiH₄/O₂/Ar discharges," Hitachi Central Research Center, Japan (August 1996).
146. S. M. Han (speaker) and E. S. Aydil, "Gas phase and surface diagnostics during plasma enhanced chemical vapor deposition of SiO₂ through SiH₄/O₂/Ar discharges," 189th Annual Electrochemical Society Meeting, Plasma Processing XI, Los Angeles, CA (May 1996).
147. S. M. Han (speaker) and E. S. Aydil, "Plasma and surface diagnostics during plasma enhanced chemical vapor deposition of SiO₂ from SiH₄/O₂/Ar discharge," International Conference on Metallurgical Coatings and Thin Films, San Diego, CA (April 1996).
148. S. M. Han and E. S. Aydil, "An *in situ* real time investigation of surface processes relevant to plasma enhanced chemical vapor deposition of SiO₂ from SiH₄/O₂/Ar discharges," 42nd National Symposium of the American Vacuum Society, Minneapolis, MN (October 1995).

PATENT APPLICATIONS AND ISSUED PATENTS

1. Sang M. Han and Talid Sinno, "Large-Scale Patterning of Germanium Quantum Dots by Stress Transfer," STC 2014-010 Invention Disclosure (July 17, 2013).
2. Sang M. Han, Scott Sibbett, Eric R. Prossnitz, Andrew P. Shreve, Mark Burge, Alejandro de la Torre, "Method and Device Design for Measuring Glycemic Time-Profiles for Hair," STC 2013-039-01 Provisional US Patent Application 61/751,372 (January 11, 2013).
3. Sang M. Han and David Wilt, "Method to Improve Radiation Degradation of Inverted Metamorphic Multi-junction (IMM) Solar Cells," UNM-2013-010 Provisional US Patent Application (August 14, 2012).
4. Olga Lavrova, Sang M. Han, Ganesh Balakrishnan, and Christos Christodoulou, "Multi-Source Optimal Reconfigurable Energy Harvester," UNM-2012-052-01 Provisional US Patent Application (January 2012).
5. Darin Leonhardt, Swapnadip Ghosh, and Sang M. Han, "Relief of Stress Caused by Thermal Expansion Mismatch Based on SiO₂ Templates Deposited Using Chemical Vapor Deposition," UNM-2011-097 US Patent Application 13/457,031 (April 26, 2012).
6. Sang M. Han, Cornelius F. Ivory, and Mani Hossein-Zadeh, "Biomarker Sensing Based on Nanofluidic Amplification and Resonant Optical Detection," UNM-2010-093 Provisional US Patent Application 61/483,327 (May 6, 2011).
7. Qiming Li and Sang M. Han, "Threading-dislocation-free nanoheteroepitaxy of Ge on Si using self-directed touch-down of Ge through a thin SiO₂ layer," UNM-2004-009 **U.S. Patent No. 7,888,244** (February 15, 2011).
8. Darin Leonhardt and Sang M. Han, "Filling Etch Pits with Dielectric Materials for Dislocation Blocking and Subsequent Growth to Achieve Low-Dislocation-Density Heteroepitaxial Films on Lattice-Mismatched Substrates," UNM-2011-048 US Patent Application 13/444,712 (April 11, 2012).
9. Josephine Sheng, Darin Leonhardt, and Sang M. Han, "Slurry-Free Chemical Mechanical Planarization (CMP) of Engineered Germanium-on-Silicon Wafers," UNM-925/UNM-2009-036 **U.S. Patent No. 8,338,301 B1** (December 25, 2012).
10. Younjin Oh, Cornelius F. Ivory, and Sang M. Han, "High Resolution Focusing and Separation of Proteins in Nanochannels," UNM-2009-031 International Patent Application PCT/US2009/61314 (October 20, 2009); US Patent Application 12/721,860 (March 11, 2010); US Patent Application 13/125,096 (April 20, 2011); Notice of allowance (July 9, 2012); **US Patent 8,303,789 B1** (November 6, 2012).
11. Qiming Li and Sang M. Han, "Threading-dislocation-free nanoheteroepitaxy of Ge on Si using self-directed touch-down of Ge through a thin SiO₂ layer," UNM-2004-009 **U.S. Patent No. 7,579,263** (August 25, 2009).
12. Darin Leonhardt and Sang M. Han, "Defect Reduction by Annealing Nanoscale Semiconductor Islands During the Initial Stage of Coalescence," UNM-960/UNM-2009-122 **U.S. Patent No. 8,242,003 B1** (August 14, 2012).
13. Qiming Li and Sang M. Han, "Ultra-Thin High-Quality Ge on Si by Low-Temperature Epitaxy and Insulator-Capped Annealing," UNM-780/UNM-2007-006 **U.S. Patent No. 7,968,438** (June 28, 2011).
14. Sang M. Han, "Surface Corrugation on Internal Reflection Infrared Waveguide for Enhanced Detection Sensitivity and Selectivity," UNM-586/UNM-2001-048 **U.S. Patent No. 7,200,311** (April 3, 2007).
15. Steve R. J. Brueck, Sang M. Han, Cornelius F. Ivory, Gabriel P. Lopez, and Dimiter N. Petsev, "Nanofluidics for Bioseparation and Analysis," UNM-675/UNM-2005-001 **U.S. Patent No. 8,105,471 B1** (January 31, 2012).

THESIS ADVISOR AND POSTGRADUATE-SCHOLAR SPONSOR

CURRENT STUDENTS, POSTDOCTORAL RESEARCHERS, AND RESEARCH PROFESSORS

Sarun Atigyanun, PhD (2013 – present)

Omar Abudayyeh, PhD (2013 – present)
Cameron Harrison, PhD (2013 – present)
Swapnadip Ghosh, PhD (2010 – present)
Emilee Sena, MS (2013 – present)
Nicholas Shoop, MS (2009 – present)

TOTAL NUMBER OF RESEARCH FACULTY AND STUDENTS ADVISED: 4 PhD and 2 MS students currently advised; 5 PhDs and 4 MSs graduated; 1 postdoctoral researcher mentored; 1 research faculty advised

PhD of Josephine J. Sheng “Empirical Correlation of Minority Carrier Lifetime to Defect Density Profile in Germanium on Silicon Heteroepitaxy” (May 6, 2013).

PhD of Louis Tribby “Experimental and Theoretical Comparison of Aspect-Ratio-Dependent Diffusion of CdSe Nanocrystals Through Nanochannels” (April 12, 2013).

PhD of Darin Leonhardt “Selective Epitaxial Growth Techniques to Integrate High-Quality Germanium on Silicon” (May 2011).

PhD of Henry Gerung “Germanium Nanomaterials: Synthesis, Characterization, and Applications” (April 6, 2006).

PhD of Qiming Li “Selective Molecular Beam Epitaxy of Germanium on Oxide-Covered Silicon” (June 17, 2005).

Plan I MS of Kyle J. Solis “Atomic-Level Investigation of Surface Processes Governing SiGe Wetting layer Formation Using STM/STS” (March 31, 2010).

Plan I MS of Madhava Kosuri "Formation of Self-Assembled Monolayers on Semiconductor Surfaces" (October 28, 2003).

Plan II MS of Alfonso Navarrete “Adhesion Output Improvement and Defect Reduction Through Enhanced TiN Process Recipes” (December 6, 2005).

Plan II MS of Jeffrey O. Stevens “Process Optimization of Polycrystalline Si Etch in Cl₂/HBr Plasma: Minimization of Isolated-to-Dense Critical Dimension Bias” (April 14, 2004).

Postdoctoral Researcher: Younjin Oh, protein and nanoparticle separations in nanofluidic FET devices (2005 – 2008)

Research Faculty: Dr. Thomas M. Mayer, Research Professor (2009 – 2011)

AWARDS

- Air Force Summer Faculty Fellowship Program (2012)
- University of New Mexico School of Engineering Teaching Award (2012)
- Science and Technology Corporation Creative Awards (2009, 2010, 2011, and 2012)
- Nomination for University of New Mexico Regents Lectureship (2011)
- Nomination for University of New Mexico School of Engineering Teaching Award (2006, 2011)
- University of New Mexico School of Engineering Junior Faculty Research Excellence Award (2005)
- Nomination for University of New Mexico Teacher of the Year (TOYA) Award (2003)
- ASEE Chemical Engineering Faculty Summer School Poster Session Winner (2002)
- National Science Foundation CAREER Award (2001)
- The Electrochemical Society Norman Hackerman Young Author Award (1998)
- National Science Foundation Summer Institute in Korea (1996)
- National Science Foundation Summer Institute in Japan (1996)