ROBERT D. GEIL

bob.geil@unc.edu

EDUCATION

VANDERBILT UNIVERSITY – Nashville, TN Spring 2005
Ph.D., Chemical Engineering

NORTH CAROLINA STATE UNIVERSITY – Raleigh, NC Spring 2000
Bachelor of Science, **Chemical Engineering,** *magna cum laude*

TECHNICAL SKILLS

Micro/nanofabrication instrumentation and techniques
Plasma-etching (DRIE, RIE), Plasma enhanced chemical vapor deposition (PECVD), Pulsed laser deposition (PLD), Atomic layer deposition (ALD), Physical vapor deposition (e-beam evaporation, RF and DC sputtering), Optical lithography, Soft lithography, Hot embossing, Laser micromilling, Maskless laser writing

Analytical instrumentation
Atomic force microscopy (AFM), Scanning electron microscopy (SEM), Spectroscopic ellipsometry, Ion beam analysis: Rutherford backscattering spectrometry (RBS) and Time-of-flight medium energy backscattering (TOF-MEBS), Reflectometry

EXPERIENCE

UNIVERSITY OF NORTH CAROLINA – Chapel Hill, NC
Technical Director, Chapel Hill Analytical and Nanofabrication Lab (CHANL) 2019-present

- Collaborate with the Chemistry department's core facilities faculty director, department chairs, and business managers to insure that laboratory recharge budget of > $250k/year is financially sound
- Supervise, guide and motivate laboratory and administrative staff of four
- Increase laboratory awareness by organizing instrumentation information sessions and outreach activities, developing a detailed website, and participating in UNC Core Facility Advocacy Committee (CFAC) events
- Support the Research Triangle Nanotechnology Network (RTNN) by participating on the executive committee, attending national conferences, and tracking user statistics
- Developed strategic planning guidelines for the long-term operational trajectory of the laboratory
- Led hiring committee for recruiting technical staff
- Collaborate with the Office of Sponsored Programs to insure that the laboratory's rates are in compliance with federal grant funding guidelines and to process industry research usage agreements
- Support new users by guiding them through the laboratory's lab management system and identifying instrumentation that best fits their research needs
- Continue to perform all tasks for cleanroom management position listed below

Cleanroom Manager, CHANL 2009-2019

- Maintain, troubleshoot, and develop processes for 15 micro/nanofabrication instruments for thin film deposition, reactive ion etching, and photolithography (DRIE, ALD, PECVD, PLD, PVD, Mask aligner, Hot embosser, Laser micromill, spectroscopic ellipsometer, profiler, reflectometer) as well as over 20 pieces of auxiliary equipment (chillers, pumps, etc.)
- Collaborate with multidisciplinary groups of university and industry clients on micro/nanofabrication projects including: dissolvable microneedle patches for drug delivery,

photonic crystals for thermophotovoltaic energy conversion, micropallet arrays for single-cell separation, and microfluidic devices for investigating cultured neurons
- Supervise and train 100+ graduate, post-doc and industry user per year to use CHANL fabrication instrumentation
- Coordinate the acquisition, installation and commissioning of major laboratory equipment
- Develop and coordinate science outreach activities for K-12 students
- Interface with UNC EHS to ensure laboratory safety compliance
- Identified and optimized process for improving throughput and uniformity of ultra-thick SU8 films
- Collaborated with local company to reverse engineer passive RFID Tag to enable in-house fabrication of these devices
- Optimized fabrication of soft lithography mold to improve throughput for local company
- Developed DRIE process for fabricating tantalum-based photonic crystals [Refs. 1-4, 6]
- Developed unconventional "tilted-UV" optical lithography technique for fabricating molds for producing microneedles [Ref. 5]

VANDERBILT UNIVERSITY – Nashville, TN (2008-2009)

Research Assistant Professor (2008-2009)
- Designed and taught 3 credit hour course on nanoscale science and technology
- Studied solvent barrier properties of parylene thin films to protect low-k dielectric structures for interconnect applications [Ref. 8]
- Continued to manage, maintain, and train new users on cleanroom instrumentation listed below

Research Associate (2005 – 2008)
- Managed and maintained cleanroom laboratory space and instruments including PECVD, metal sputtering, reactive ion etching (RIE), atomic force microscopy (AFM), ion beam accelerators, and mask aligner for micro/nanoscale research
- Training and process development guidance for new users on laboratory equipment
- Collaborated with architects and faculty on the design and installation of new cleanroom facility
- Developed standard operating procedures (SOPs) for nanofabrication laboratory and instruments
- Analyzed and fabricated thin film semiconductor structures with university and industry partners
- Developed and implemented laboratory demonstrations for talented middle school students

PUBLICATIONS

1. R. Sakakibara, V. Stelmakh, W.R. Chan, **R. D. Geil**, S. Krämer, T. Savas, M. Ghebrebrhan, J. D. Joannopoulos, M. Soljačić, I. Čelanović, "A high-performance, metallodielectric 2D photonic crystal for thermophotovoltaics." Solar Energy Materials and Solar Cells **2022**, 238, 111536
2. V. Rinnerbauer, E. Lausecker, F. Schaeffler, P. Reininger, G.Strasser, **R. D**.; **Geil,** J. D. Joannopoulos, M Soljacic, I. Celanovic, "Nanoimprinted superlattice metallic photonic crystal as ultraselective solar absorber." Optica **2015**, 2(8), 743-746.
3. Rinnerbauer, V; Lenert, A; Bierman, DM; Yeng, YX; Chan, WR; **Geil, R. D.**; Senkevich, JJ; Joannopoulos, JD; Wang, EN; Soljacic, M; Celanovic, I. "Metallic Photonic Crystal Absorber-Emitter for Efficient Spectral Control in High-Temperature Solar Thermophotovoltaics." Adv. Energy Mat. **2015**, 4(12), 1400334
4. V. Stelmakh, V. Rinnerbauer, **R. D. Geil**, P.R. Aimone, J. J. Senkevich, J. D. Joannopoulos, M. Soljai, Ivan Celanovic, "High-temperature tantalum tungsten alloy photonic crystals: Stability, optical properties, and fabrication." Appl. Phys, Lett. **2013**, 103(12), 123903.

5. K. A. Moga, L. R. Bickford, **R. D. Geil**, S. S. Dunn, A. A. Pandya, Y. Wang, J. H. Fain, C. F. Archuleta, A. T. O'Neill, and J. M. DeSimone, "Rapidly–Dissolvable Microneedle Patches Via a Highly Scalable and Reproducible Soft Lithography Approach." Adv. Mater. **2013**, 25(36), 5060-5066.
6. V. Rinnerbauer, S. Ndao, Y. X. Yeng, J. J. Senkevich, K. F. Jensen, J. D. Joannopoulos, M. Soljacic, I. Celanovic, and **R. D. Geil**, "Large-area fabrication of high aspect ratio tantalum photonic crystals for high-temperature selective emitters." J. Vac. Sci. Technol. B **2013,** 31(1), 011802.
7. D. S. Koktysh, J. R. McBride, **R. D. Geil**, B. W. Schmidt, B. R. Rogers, S. J. Rosenthal, **"**Facile route to SnS nanocrystals and their characterization." Mat. Sci. and Eng. B **2010,** 170(1-3), 117-122.
8. **R. D. Geil**, J. J. Senkevich, B. R. Rogers. "Method for measuring solvent permeation through polymer film on porous dielectric films." J. Vac. Sci. Technol. B **2009,** 27(4), 1825-1828.
9. **R. D. Geil**, B. R. Rogers, M. H. Mendenhall, R. A. Weller. "Effect of Multiple Scattering and Surface Roughness on Medium Energy Backscattering Spectra." Nucl. Inst. and Meth. B **2007,** 256(2), 631-637.
10. R. Raghuveer, S. L. Burkett, L. W. Schaper, R. K. Ulrich , B. R. Rogers, and **R. D. Geil.** "Dual Process Dielectric Formation for Decoupling Capacitors on Flexible Substrates." IEEE Trans. Comp. Packaging Technol. **2007,** 30(4), 579-584.
11. **R. D. Geil**, B. R. Rogers, R. A. Weller, J. L. Hilton. "Evaluation of Depth Resolution with Time-of-Flight Medium Energy Backscattering." Nucl. Inst. and Meth. B **2006,** 243(2), 377-384.
12. J. J. Senkevich, B. W. Woods, B. P. Carrow, **R. D. Geil**, B. R. Rogers. **"**Amorphous Highly Conjugated Chemical-Vapor-Deposited Polymer Thin Films." Chemical Vapor Deposition **2006**, 12(5), 285-289.
13. B. R. Rogers, Z. Song, **R. D. Geil**, R. A. Weller. "Optimization of UHV-CVD Thin Films for Gate Dielectric Applications." Advances in Science and Technology **2006,** 45, 1351-1354.
14. S. Spiesshoefer, J. Patel, T. Lam, L. Cai, S. Polmreddy, R. F. Figueroa, S. L. Burkett, L. Schaper, **R. D. Geil**, B. R. Rogers. "Copper Electroplating to Fill Blind Vias for Three-dimensional Integration." J. Vac. Sci. Technol. A **2006,** 24(4).
15. **R. D. Geil**, B. R. Rogers, Z. Song, R. A. Weller. "Interfacial Analysis Using Time-of-Flight Medium Energy Backscattering." J. Vac. Sci. Technol. A 2004, 24(4), 1277-1282.
16. X. Hu, A. P. Karmarkar, B. Jun, D. M. Fleetwood, R. D. Schrimpf, **R. D. Geil**, R. A. Weller, B. D. White, M. Bataiev, L. J. Brillson, U. K. Mishra, "Proton-irradiation effects on AlGaN/AlN/GaN high electron mobility transistors." IEEE Trans. Nucl. Sci. **2003**, 50(6), 1791-1796.

ORAL PRESENTATIONS

1. "Micro and nanopatterning approaches of hybrid perovskites" RT-REU (2022)
2. "Overview of CHANL fabrication capabilities" Research Triangle-REU (2022)
3. "Overview of UNC etch capabilities" NNCI Etch Symposium (2022)
4. "Overview of CHANL capabilities" UNC Chemistry Core Staff (2022)
5. "Overview of CHANL capabilities" Dept. Applied Phy. Sci. (2022)
6. "Overview of CHANL capabilities" Dept. Applied Phy. Sci. (2021)
7. "Overview of CHANL capabilities" Dept. Applied Phy. Sci. (2020)
8. "Overview of CHANL capabilities" East Carolina University, *invited* (2018)
9. "Photolithography, thin film deposition, and soft lithography" How to Make It Workshop (2017)
10. "Overview of UNC etch capabilities" NNCI Etch Symposium (2016)
11. "Tantalum photonic crystal fabrication" NNCI Etch Symposium (2016)

12. “Overview of UNC atomic layer deposition (ALD) capabilities” NNCI ALD Symposium (2016)

COURSE DEMONSTRATIONS

1. PHYS 481L: Advanced Laboratory I (Spring 2022 - 2023)
2. PHYS 53: Handcrafting in the Nanoworld (Spring 2016 - 2021)
3. PHYS 119: Introductory Calculus-based Electromagnetism and Quanta (Spring 2015 - 2016)
4. ENGL 105: English Comprehension and Rhetoric: Science Unit (Fall 2015)
5. PHYS 119: Introductory Calculus-based Electromagnetism and Quanta (Spring 2014)
6. CHEM 241H: Modern Analytical Methods for Separation and Characterization: (Fall 2013)
7. BMME 490: Special Topics in Biomedical Engineering (Fall 2013)

OUTREACH/EDUCATION

1. North Carolina School of Science and Math, demonstration and tour (2019 – 2022)
2. UNC Cores Showcase, representative (2022)
3. Norfolk Academy, demonstration and tour (2022)
4. CHANL Microfabrication Techniques Video, coordinator (2022)
5. UNC Cores Highlights Video, coordinator (2021)
6. CHANL TEM Open House, coordinator (2019)
7. NC Science Expo, demonstration and tour (2010 – 2019)
8. CHANL Scientific Art Competition, coordinator (2010 – 2019)
9. GE Girl’s STEM Summer Camp, demonstration and tour (2017 – 2019)
10. CHANL Open House, coordinator (2018)
11. Davie High School, demonstration and tour (2017)
12. UNC Chancellor’s Science Scholars, demonstration and tour (2016)
13. “Nanotechnology: A Makers Course” Coursera content developer (2016)
14. Durham Academy, demonstration and tour (2016)
15. NanoDays, demonstration (2011)
16. CHANL Open House, coordinator (2011)

TEACHING/MENTORING

8. Physics Lab 481L: Advanced Laboratory I (Spring 2022 - 2023)
1. Mentor for UNC BME undergraduate student, senior honors thesis (2022-2023)
2. Undergraduate work-study supervisor (Fall 2019)
3. Mentor for UNC Physics graduate student (2017-2019)
4. 3 credit hour course on nanoscale science and technology (Spring 2008)

PROFESSIONAL SERVICE

1. RTNN Executive Committee, member (2018-present)
2. Carolina Science Symposium, committee member (2022)
3. NNCI Working group: Instrumentation Maintenance, member (2016-present)
4. NNCI Working group: Atomic Layer Deposition, member (2016-present)
5. Spectroscopic Ellipsometry workshop, organizer (2015)
6. “How To Make It” Microfluidics workshop, organizer (2016)