

# Andrew Peters

University of Minnesota, 207 Pleasant St SE, Minneapolis, MN 55455  
pete8690@umn.edu • (410) 852-5908

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## EDUCATION and APPOINTMENTS

### University of Minnesota

*Postdoctoral Research Associate*

Minneapolis, MN

*Present*

- Advisor: Timothy P. Lodge
- Research topic: Fundamental understanding of chain exchange and relaxation time in micelle forming ABA and BAB systems using rheology, SAXS, light scattering, and simulation tools.

### Georgia Institute of Technology

*Ph.D. Chemical and Biomolecular Engineering*

Atlanta, GA

*August 2015*

- Advisor: Clifford L. Henderson
- Thesis topic: Mesoscale simulation of diblock copolymer phase separation and directed self-assembly processes for semiconductor manufacturing.

### University of Maryland

*B.S. Chemical Engineering; Philosophy Minor*

College Park, MD

*May 2010*

- Advisor: Michael Zachariah
- Research Topic: Propagation velocities of thermite reactions using aluminum nanoparticles.

## PUBLICATIONS

1. **Andrew J. Peters**, Timothy P. Lodge, “Comparison of Gel Relaxation Times and End-block Pullout Times in ABA Triblock Copolymer Networks” *Macromolecules*, 49, 7340-7349 (2016).
2. **Andrew J. Peters**, Richard A. Lawson, Benjamin D. Nation, Peter J. Ludovice, Clifford L. Henderson, “Calculations of the free energy of dislocation defects in lamellae forming diblock copolymers using thermodynamic integration” *J. Micro-Nanolith. Mem.* 15, 023505 (2016). (**Featured Article**)
3. **Andrew J. Peters**, Richard A. Lawson, Benjamin D. Nation, Peter J. Ludovice, Clifford L. Henderson, “Coarse-grained molecular dynamics modeling of the kinetics of lamellar block copolymer defect annealing” *J. Micro-Nanolith. Mem.* 15, 013508 (2016). (**Cover Article**)
4. **Andrew J. Peters**, Richard A. Lawson, Benjamin D. Nation, Peter J. Ludovice, Clifford L. Henderson, “Simulation study of the effect of molar mass dispersity on domain interfacial roughness in lamellae forming block copolymers for directed self-assembly” *Nanotechnology*, 26, 385301 (2015).
5. **Andrew J. Peters**, Benjamin D. Nation, Richard. A. Lawson, Peter J. Ludovice, Clifford L. Henderson, “Free energy difference of pitch variation and calculation of the order–disorder transition in block copolymer systems using thermodynamic integration” *Mat. Res. Express*, 2, 075301 (2015)
6. Richard Lawson, **Andrew Peters**, Benjamin Nation, Peter Ludovice, Clifford Henderson, “Simulation study of the effect of differences in block energy and density on the self-assembly of block copolymers” *J. Micro-Nanolith. Mem.*, 31, 031308, (2014).
7. **Andrew J. Peters**, Richard A. Lawson, Peter J. Ludovice, Clifford L. Henderson, “Detailed molecular dynamics studies of block copolymer directed self-assembly: Effect of guiding layer properties” *J. Vac. Sci. Technol. B*, 31, 06F302, (2013).

- **Andrew J. Peters**, Benjamin D. Nation, Daniel Nicoloso, Peter J. Ludovice, Clifford L. Henderson, “Protracted Colored Noise Dynamics in Molecular Dynamics Simulations of Block Copolymers” *In Preparation*.
- **Andrew J. Peters**, Timothy P. Lodge, “Chain exchange kinetics of asymmetric BAB and ABB branched triblock polymers” *In Preparation*.

### **AWARDS and FELLOWSHIPS**

- Cover Art Journal of Micro/Nanolithography, MEMS, and MOEMS 2016
- Featured Article Journal of Micro/Nanolithography, MEMS, and MOEMS 2016
- Georgia Tech Research and Innovation Conference Fellowship 2012 - 2013
- Best Paper at International Symposium on Lithography Extensions 2011

### **SELECTED CONFERENCE PROCEEDINGS (of 14)**

1. **Andrew J. Peters**, Richard A. Lawson, Benjamin D. Nation, Peter J. Ludovice and Clifford L. Henderson, “Coarse-grained molecular dynamics modeling of the kinetics of lamellar BCP defect annealing” Proc. SPIE, 9423, 94231Y, (2015).
2. **Andrew J. Peters**, Richard Lawson, Benjamin D. Nation, Peter J. Ludovice, Clifford L. Henderson, “Understanding defects in DSA: Calculation of free energies of block copolymer DSA systems via thermodynamic integration of a mesoscale block-copolymer model” Proc. SPIE, 9049, 90492E, (2014).
3. **Andrew J. Peters**, Richard Lawson, Peter J. Ludovice, Clifford L. Henderson, “Effects of block copolymer polydispersity and  $\chi_N$  on pattern line edge roughness and line width roughness from directed self-assembly of diblock copolymers” Proc. SPIE, 8680, 868020, (2013).
4. Richard A. Lawson, **Andrew J. Peters**, Peter Ludovice, Clifford L. Henderson, “Coarse grained molecular dynamics model of block copolymer directed self-assembly” Proc. SPIE, 8680, 86801Y, (2013).
5. **Andrew J. Peters**, Richard Lawson, Peter J. Ludovice, Clifford L. Henderson, “Detailed mesoscale dynamic simulation of block copolymer directed self-assembly processes: application of protracted colored noise dynamics,” Proc. SPIE, 8323, 83231T, (2012).

### **SELECETED PRESENTATIONS (of 26)**

1. “Rapid End-Block Pullout in ABA Triblock Polymer Gels” American Institute of Chemical Engineers Annual Conference 2016, San Francisco, CA, November 2016.
2. “Rheology and Relaxation Timescales of an ABA Triblock Polymer Gel” American Physical Society March Meeting 2016, Baltimore, MD, March 2016.
3. “Protracted Colored Noise Dynamics for Polymer Systems” American Institute of Chemical Engineers Annual Conference 2014, Atlanta, GA, November, 2014.
4. “Diblock Copolymer Directed Self-Assembly Line Roughness: Effects of Polydispersity and  $\chi_N$ ” American Institute of Chemical Engineers Annual Conference 2013, San Francisco, CA, November 2013.

5. "Detailed Molecular Dynamics Studies of Block Copolymer Directed Self-Assembly: Effect of Guiding Layer Properties" Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication 2013, Nashville, TN, May 2013.
6. "Molecular dynamics simulations of block copolymer directed self-assembly: Understanding the limits and guiding materials design" 2012 Litho Workshop. June 2012.

## **RESEARCH EXPERIENCE**

### **University of Minnesota**

**Minneapolis, MN**

*Postdoctoral Associate with Prof. Timothy Lodge*

*June 2015 - present*

*Project Title: "Chain Exchange and Relaxation times in Micelle Forming ABA and BAB Systems"*

- Used rheology to find that ABA triblock polymers relax significantly faster than is to be expected based on previous diblock experiments. Explained this via dispersity and entropic effect in the midblock.
- Modeling of dispersity in ABA triblock polymer systems to show that higher dispersity polymers relax more quickly because the shorter chain ends are more likely to be sampled.
- Use of DPD simulations to find that BAB triblock polymers chain exchange significantly faster than equivalent AB diblock polymers. The effect of asymmetry in the B blocks on exchange is underway.

### **Georgia Institute of Technology**

**Atlanta, GA**

*Graduate Research Assistant with Prof. Clifford Henderson*

*2010 - 2015*

*Project Title: "Mesoscale Simulation of Diblock Copolymer Phase Separation and Directed Self Assembly Processes: Applications for Semiconductor Manufacturing"*

- Developed coarse grained block copolymer models for use in molecular dynamics simulations of block copolymer phase separation.
- Investigated the effect of polymer properties and processing conditions on equilibrium defect density and defect removal kinetics. Defects are perhaps the primary hurdle to block copolymer directed self-assembly use in semiconductor fabrication.
- Investigated the effects of underlayer pattern quality, polymer interaction, and polymer dispersity on line roughness, a critical parameter in semiconductor lithography.

### **University of Maryland**

**College Park, MD**

*Undergraduate Research Assistant with Prof. Michael Zachariah*

*2008*

*Project Title: "Propagation velocities in thermite reactions using aluminum nanoparticles"*

- Constructed an apparatus to safely initiate, propagate, and measure the reaction propagation velocity of various oxides and aluminum nanoparticles.
- Explored the effect of various oxides on the reaction propagation velocity.
- Designed and performed simulations to calculate reaction temperatures.

## **TEACHING EXPERIENCE**

### **Teaching Fellow**

*2013*

*Georgia Institute of Technology; Numerical Methods*

- Designed and delivered 12 lectures throughout the fall semester.
- Planned weekly homework assignments and quizzes. Planned a final project that incorporated various aspects of the class.
- Held weekly recitations to review lecture material.

### **Teaching Assistant (x3)**

*2012 - 2015*

*Georgia Institute of Technology; Chemical Process Control; Unit Operations Laboratory*

- Held weekly recitations to review lecture material.
- Held weekly office hours for questions and review.
- Prepared and supervised weekly laboratory sections.

#### **Research Supervisor for Undergraduate Students**

2012 - 2015

*Georgia Institute of Technology and University of Minnesota*

- Supervised five students. Four in the area of block copolymer simulation and one in the area of rheology of ABA triblock polymer gels.
- Daniel Nicoloso (undergraduate student at Georgia Tech) won second place in the subdivision poster competition at the 2014 AIChE conference.
- Students presented posters at the national AIChE conference and at the Air Products Symposium.

#### **Science Tutor for Underprivileged Students**

2015

*Atlanta, GA*

- Tutored middle and high school students once a week on scientific topics.

### **PROFESSIONAL ACTIVITIES**

- Reviewer for Optical Engineering 2016 - present
- American Institute of Chemical Engineers 2008 - present
- APS (American Physical Society) 2016 - present
- SPIE – the International Society for Optics and Photonics 2011 - 2015
- Georgia Tech Presidents Undergraduate Research Awards Reviewer 2013

### **OTHER**

#### **President of FCGS graduate student group**

2013 - 2015

*Georgia Institute of Technology*

- Organized weekly meetings and invited speaker talks.
- Organized outreach events.
- Coordinated with outside groups for large events (~1000 students).

## REFERENCES

**Dr. Timothy Lodge, *Postdoctoral Advisor***

Regents Professor

Department of Chemical Engineering and Materials Science / Department of Chemistry

University of Minnesota

207 Pleasant St SE

Minneapolis, MN 55455-0431

✉ lodge@umn.edu

☎ (612) 625-0877

**Dr. Clifford Henderson, *Graduate Advisor***

Chair and Professor

Department of Chemical and Biomedical Engineering

University of South Florida

4202 E. Fowler Avenue

Tampa, FL 33612

✉ clhenderson@usf.edu

☎ (813)-974-6354

**Dr. Peter J. Ludovice, *Collaborator***

Associate Professor

School of Chemical and Biomolecular Engineering

Georgia Institute of Technology

311 Ferst Drive NW

Atlanta, GA 30332-0100

✉ pete.ludovice@chbe.gatech.edu

☎ (404) 894-1835