



Macromolecules
Innovation Institute
At the intersection of science, engineering, and society



ACS
Chemistry for Life®

Receive hands-on training in diagnosing and solving your additive manufacturing R&D problems!

The American Chemical Society Presents...

Polymeric Materials for Additive Manufacturing

Compelling Reasons to Register for This Course:

1. Understand Practical Uses of Additive Manufacturing Methods and the Predictive Structure-Property-Processing Relationships.
2. Design Novel Polymeric Materials with a Balance of Reactivity, Resolution, and Rheology for Diverse Printing Platforms
3. Work and Consult with Renowned Authorities in the Additive Manufacturing Field.
4. Acquire Hands-on Experience by Performing or Discussing a Variety of Experiments in a Small Group Laboratory Environment.
5. Gain a Remarkable Breadth of Knowledge of 3D Printing - Covering a Variety of Topics from Thermoplastic Design to Solution Rheology.
6. Solve Your Practical, Work-Related Problems by Discussing Your Work with Additive Manufacturing and Polymer Experts.

Inaugural Course offered Spring 2022:

Sunday evening – Friday noon
May 15-20, 2022

The course is held at Virginia Tech, Blacksburg, Virginia USA

Register Today at: www.ProEd.acs.org

Enrollment in this exceptionally popular course is strictly limited to 30 participants. Sessions sell out quickly. Don't delay!



Who Should Attend?

Anyone currently working or beginning to work with additive manufacturing and its applications, including bachelor degree through Ph.D. level research chemists, engineers, physicists, or technicians should take this course. Managers in the polymer industry will greatly benefit from this in-depth, lecture-laboratory course. No prior knowledge of additive manufacturing is assumed. Although some introductory lectures are included on polymer science and engineering, some working knowledge of polymer chemistry would be useful. This course is also ideal for K-12 teachers and university professors who wish to integrate additive manufacturing principles into their courses.

Note: Because of the amount of lab work, enrollment is strictly limited to 30 people. Each participant should bring comfortable clothing, arriving early enough on Sunday to have a meal and be well rested for the first evening session.

What You'll Learn

The fundamentals of additive manufacturing

Design of polymer structure that aligns with diverse printing platforms

Correlation of structure-property- processing relationships to accelerate innovation

Comprehensive Program Agenda

SUNDAY

| | | | | |
|------|---|------|----|---|
| 4:30 | – | 5:00 | PM | Registration |
| 5:00 | – | 5:30 | PM | Welcome and Outline of Course: Resolution, Rheology & Reactivity (Williams) |
| 5:30 | – | 6:30 | PM | Resolution: Additive Manufacturing Processes (Williams) |
| 6:30 | – | 6:45 | PM | Break |
| 6:45 | – | 7:45 | PM | Rheology: Polymer Rheology in AM Processes (Bortner) |
| 7:45 | – | 8:00 | PM | Break |
| 8:00 | – | 9:00 | PM | Reactivity: Polymer Terminology and Classes (Long) |

MONDAY

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|-------|---|-------|----|--|
| 8:00 | – | 9:15 | AM | Rheology in Extrusion-Based Additive Manufacturing I (Bortner) Fused Filament Fabrication |
| 9:15 | – | 9:25 | AM | Break |
| 9:25 | – | 10:40 | AM | Thermoplastic Design and Properties (Long) |
| 10:40 | – | 10:50 | AM | Break |
| 10:50 | – | 12:05 | PM | Rheology in Extrusion-Based Additive Manufacturing II (Bortner) Fused Filament Fabrication and Direct Ink Write |
| 12:05 | – | 1:20 | PM | Lunch Together |
| 1:30 | – | 3:30 | PM | Extrusion Based AM Lab (CRC, capillary rheology and FFF) |
| 3:45 | – | 4:00 | PM | Break |
| 4:00 | – | 5:00 | PM | Structure-Property Relationships of Printed FFF Parts (Williams) |

Monday Evening Free

TUESDAY

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|-------|---|-------|----|--|
| 8:00 | – | 9:15 | AM | Photopolymerization-Based Additive Manufacturing (Williams) Vat Photopolymerization, UV-DIW, & Material Jetting |
| 9:15 | – | 9:30 | AM | Break |
| 9:45 | – | 11:45 | AM | Lab, (MCL – chemical, physical and thermal characterization of polymers) |
| 12:00 | – | 1:15 | PM | Lunch Together |
| 1:15 | – | 2:30 | PM | Influence of Light on Viscoelasticity (Bortner) |
| 2:30 | – | 2:40 | PM | Break |
| 2:40 | – | 3:45 | PM | Structure-Property Relationships of Photo-reactive Polymers I (Long) |
| 3:45 | – | 4:00 | PM | Break |
| 4:00 | – | 5:15 | PM | Structure-Property Relationships of Photo-reactive Polymers II (Long) Tuesday Evening Free |

WEDNESDAY

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|-------|---|-------|----|---|
| 8:00 | – | 9:15 | AM | Introduction to Thermal Properties of Polymers (Bortner) |
| 9:15 | – | 9:30 | AM | Break |
| 9:30 | – | 10:45 | AM | Polymer Powder Bed Fusion Additive Manufacturing (Williams) |
| 10:45 | – | 11:00 | AM | Break |
| 11:00 | – | Noon | | Structure-Property Relationships of PBF Materials (Long) |
| 12:00 | – | 1:30 | PM | Lunch Together |
| 1:30 | – | 2:45 | PM | Processing in PBF and Structure-Properties (Williams) |
| 2:45 | – | 3:00 | PM | Break |
| 3:00 | – | 5:30 | PM | PBF and VP Additive Manufacturing Processes Lab (DREAMS Lab) Wednesday Evening Free |

THURSDAY

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|-------|---|-------|----|--|
| 8:00 | – | 9:15 | AM | Jetting Additive Manufacturing Processes (Williams) Binder Jetting & Material Jetting |
| 9:15 | – | 9:30 | AM | Break |
| 9:30 | – | 10:45 | AM | Solution Rheology (Bortner) |
| 10:45 | – | 11:00 | AM | Break |
| 11:00 | – | 12:15 | PM | Polymers for Jetting (Long) |
| 12:15 | – | 1:45 | PM | Lunch Together |
| 1:45 | – | 4:30 | PM | Jetting & Extrusion Additive Manufacturing Processes Lab (DREAMS Lab) |
| 5:00 | – | 7:00 | PM | ACS Networking Reception, Bull and Bones, casual dress. |

FRIDAY

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|-------|---|-------|----|--|
| 8:00 | – | 9:15 | AM | Emerging Topics in Additive Manufacturing Processes (Williams) |
| 9:15 | – | 9:30 | AM | Break |
| 9:30 | – | 10:30 | AM | Emerging Topics in Materials Design for Additive (Long) |
| 10:30 | – | 10:45 | AM | Break |
| 10:45 | – | 11:45 | AM | Emerging Topics in Properties and Performance of Printed Objects (Bortner) |

About the Faculty

Dr. Timothy E. Long received his Ph.D. in Chemistry from Virginia Tech under the direction of Prof. James McGrath, and he subsequently joined both Eastman Kodak and Eastman Chemical companies for eight years upon graduation. He joined the faculty in the Department of Chemistry at Virginia Tech, where he also served as the Director of the Macromolecules Innovation Institute until 2019. In 2020, Prof. Long accepted an interdisciplinary faculty position across the School of Molecular Sciences (SMS) and the School for Engineering Matter, Transport, and Energy (SEMTE) at Arizona State University (ASU) where he launched and currently leads the Biodesign Center for Sustainable Macromolecular Materials and Manufacturing (SM3).

In addition to over 400 peer-reviewed publications, his research awards include:

- 2022 Paul J. Flory Award
- 2020 Virginia Outstanding Faculty Award
- 2015 Virginia Scientist of the Year
- 2010 Virginia Tech Alumni Research Award
- ACS PMSE Collaborative Research Award
- PSTC Carl Dahlquist Award
- 2019 ACS Rubber Division Thermoplastic Elastomer Award
- ACS POLY Mark Scholar Award

His most recent research efforts address the need for tailored advanced macromolecules for advanced manufacturing (3D printing), including vat photopolymerization, direct ink write, binder jetting, powder bed fusion, and melt extrusion. His interdisciplinary research establishes fundamental polymer structure-property-processing relationships with a lens of sustainability.

Dr. Michael J. Bortner is an associate professor in the Department of Chemical Engineering and a Faculty Fellow in the College of Engineering at Virginia Tech. Dr. Bortner has a decade of industry experience working in polymer and composite materials and process development. He was a Senior Process Engineer at Nuvotronics and a VP of Manufacturing Process Development at NanoSonic before returning to Virginia Tech as a Professor in the Department of Chemical Engineering. His interdisciplinary research team focuses on process-structure-property relationships in polymers and polymer composites, coupling rheology and morphology to guide development of novel chemistries and design of new manufacturing processes.

Dr. Christopher Williams is the L. S. Randolph Professor and the Electro-Mechanical Corporation Senior Faculty Fellow in the Department of Mechanical Engineering at Virginia Tech. He is Director of the Design, Research, and Education for Additive Manufacturing Systems (DREAMS) Laboratory, and former Director of the Macromolecules Innovation Institute at the University. He has conducted research in Additive Manufacturing for over 20 years, and has published over 185 peer-reviewed articles that span the entire value chain of Additive Manufacturing, including design for AM methodologies, novel AM processes and materials, and cyber-physical security. He is a recipient of a National Science Foundation CAREER Award (2013) and the 2012 Outstanding Young Researcher in Freeform and Additive Manufacturing Award (FAME Jr. Award; presented by the Solid Freeform Fabrication Symposium). He currently serves as the Chair of the Additive Manufacturing Technical Community Advisors for SME.

Course Fee

Check the ACS website to see current member and non-member pricing

www.ProEd.acs.org

Course Location

All lectures are typically held at the **Inn at Virginia Tech**, second floor. Laboratory sessions are held on VT campus in the DREAMS Lab in Goodwin Hall, the Materials Characterization Laboratory, and the Polymer Composite and Materials Laboratory. A guide will escort participants to labs. In case of inclement weather, a van will be provided at the front door of The Inn immediately following lecture.

Lodging Information

The guestroom blocks will be held until one month before each session. To ensure that you are able to book a room at this special rate, we urge you to make your hotel reservation as soon as possible, mentioning that you are an American Chemical Society short course participant. Please check the ACS website for the course location, or contact the MII administration at mii@vt.edu.

The closest airport is in Roanoke, VA, about 45 minutes drive from Blacksburg. For those wishing to rent a car, all major rental car agencies have facilities at the Roanoke Airport. Alternatively, bus service is available through Smart Way Bus (www.smartwaybus.com) which will bring you directly to the Virginia Tech campus.

Payments/Cancellations

All registrations must be prepaid. You may register online or via mail. Please go to the ACS website for full registration instructions.

If you need to cancel your enrollment, you may do so up to ten (10) business days before the session and still receive a refund of your registration fee, minus a \$50 administration fee. The specific cancellation date will be provided in your confirmation letter. After that time, no refund or credit will be issued but you may have a co-worker attend in your place.

See you in Blacksburg!



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