The Australian Society of Rheology, Inc.

2022-23 Rheology Guest Lecture

CAV Reg. No. A0055806E

The Australian Society of Rheology is hosting a guest lecture in a hybrid format (virtual as well as in person) which is open to anyone interested in the flow and deformation of matter.

Calendar details

Date:	**Friday, December 09, 2022**
Time:	4:00 to 5:00 PM (University of Melbourne, Australia)
Eventbrite link:	https://www.eventbrite.com.au/e/australian-society-of-rheology-guest-lecture-09-december-2022-registration-469508872677
Venue:	**Steve Howard Room, Level 5, Melbourne Connect, 700 Swanston St, University of Melbourne (Parkville Campus)**

Invited lecture

Dr Michelle A. Calabrese

(Department of Chemical Engineering and Materials Science, University of Minnesota)

Presentation Title: New approaches to dripping-onto-substrate (DoS) extensional rheometry to assess injectability and coatability in complex fluids

Abstract: Injectability, sprayability, and printability in complex fluids are dictated by the extensional flow properties. Until recently, the extensional rheology of protein medications and other low viscosity fluids has been sparsely studied due to experimental limitations. Most extensional rheology devices yield mixed shear and extensional flows, cover limited extension rates, require multiple loadings, and are not commercially available. However, capillary-driven thinning of a liquid bridge – in which filament thinning can be mathematically described by distinct behavioral regimes accounting for inertial, viscous, elastic, and capillary forces – can be used to accurately measure rheological parameters. To measure scarce materials and low viscosity fluids in truly small volumes, we have developed instrumentation for simultaneous dripping-onto-substrate (DoS) extensional rheology and surface tension measurements in <10 μL/trial over a range of temperatures, humidities, and organic solvents. Here, we demonstrate the utility of capillary-driven thinning to determine injectability and coatability for three case studies: protein therapeutics, thermoresponsive self-assembling polymers, and polymers in volatile organic solvents. In the first, we show that common polymeric excipients added to stabilize proteins in shear flows produce adverse behavior in extension that can cause protein denaturing. Next, we demonstrate the utility of our newly-developed chamber that enables temperature-controlled DoS (TC-DoS) measurements of block copolymer micelle solutions. While spherical micelles at ambient conditions exhibit inertiocapillary (IC) thinning, above the sphere-to-rod transition temperature, liquid bridge thinning evolves towards viscocapillary (VC) behavior or elastocapillary (EC) thinning once micelles are sufficiently long and entangled. Finally for polymer solutions in organic solvents, we employ a new environmental control system to confirm scaling relationships in chloroform for the first time, and also show that evaporation effects during measurement can depend more on polymer mobility than solvent vapor pressure. These case studies illustrate the utility of solution extensional rheology for predicting injectability and coatability, enabling rapid formulation screening using a single drop.

Speaker's biography

Michelle A. Calabrese
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Michelle A Calabrese is an assistant professor in the Department of Chemical Engineering and Materials Science at the University of Minnesota. She received her BS in Chemical Engineering from the University of Pennsylvania in 2012. She completed her PhD in Chemical Engineering at the University of Delaware in 2017, where she focused on developing new techniques in rheology and neutron scattering to understand the flow properties of complex fluids. Following her postdoc in chemical engineering at MIT, she joined the faculty at UMN in mid-2019. Her research group employs rheology, soft matter physics, and polymer and nanoparticle synthesis to address a range of fundamental and applied problems in polymer and soft materials engineering. Her recent recognitions include the 3M Non-tenured Faculty Award, NSF CAREER Award, and NIH NIDCD Early Career Research Award (R21).

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