The Australian Society Of Rheology, Inc.

2020-21 Rheology Lecture Series

CAV Reg. No. A0055806E

Calendar details

Date:	**Tuesday, 23 February 2021**
Time:	**9:00 - 10:30 am (Melbourne, Australia)**
Event Registration:	**https://www.eventbrite.com.au/e/australian-society-of-rheology-seminar-23-february-2021-registration-132177467363**

Invited lecture

Professor Timothy P. Lodge

(Department of Chemistry and Department of Chemical Engineering & Materials Science, University of Minnesota, Minneapolis, MN)

Equilibrium and Dynamics in Block Copolymer Micelles

Block copolymers provide a remarkably versatile platform for achieving desired nanostructures by self-assembly, with length scales ranging from a few nanometers up to several hundred nanometers. In particular, block copolymer micelles in selective solvents are of great interest across a range of technologies, including drug delivery, imaging, catalysis, lubrication, and extraction. While block copolymers generally adopt the morphologies familiar in small molecule surfactants and lipids (*i.e.*, spherical micelles, worm-like micelles, and vesicles), one key difference is that polymeric micelles are typically not at equilibrium. The primary reason is the large number of repeat units in the insoluble block, N_{core}, which makes the thermodynamic penalty for extracting a single chain ("unimer exchange") substantial. As a consequence, the critical micelle concentration (CMC) is rarely accessed experimentally; however, in the proximity of a critical micelle temperature (CMT), equilibration is possible. We use time-resolved small angle neutron scattering (TR-SANS) to obtain a detailed picture of the mechanisms and time scales for chain exchange, for systems at or near equilibrium. The dependence of the rate of exchange on the key variables – concentration, temperature, N_{core}, N_{corona}, and chain architecture (diblock versus triblock) – will be discussed. Interestingly, almost none of the observed features are captured by available theory. Then, when micelles are significantly larger or smaller than the equilibrium size, fragmentation and fusion mechanisms, respectively, can become operative. We will describe measurements using dynamic light scattering, small-angle X-ray scattering, and liquid-phase TEM to follow the fragmentation process in detail.

Speaker's biography

Tim Lodge graduated from Harvard in 1975 with a B.A. cum laude in Applied Mathematics. He completed his PhD in Chemistry at the University of Wisconsin in 1980, and then spent 20 months as a National Research Council Postdoctoral Fellow at NIST. Since 1982 he has been on the Chemistry faculty at Minnesota, and in 1995 he also became a Professor of Chemical Engineering & Materials Science. In 2013 he was named a Regents Professor, the University's highest academic rank.

He has been recognized with the American Physical Society (APS) Polymer Physics Prize (2004), the International Scientist Award from the Society of Polymer Science, Japan, (2009), the 2010 Prize in Polymer Chemistry from the American Chemical Society (ACS), and the Hermann Mark Award (2015) and the Paul Flory Education

Award (2018) of the ACS Division of Polymer Chemistry. He has been elected to Fellowship in the American Association for the Advancement of Science, the APS, the ACS, and the Neutron Scattering Society of America. In 2016 he was elected to the American Academy of Arts and Sciences.

From 2001–2017 Tim served as the Editor-in-Chief of the ACS journal *Macromolecules*. In 2011 he became the founding Editor for *ACS Macro Letters*. He has served as Chair of the Division of Polymer Physics, APS (1997–8), and as Chair of the Gordon Research Conferences on *Colloidal, Macromolecular and Polyelectrolyte Solutions* (1998) and *Polymer Physics* (2000). Since 2005 he has been Director of the NSF-supported Materials Research Science & Engineering Center at Minnesota. He has authored or co-authored over 450 papers in the field of polymer science and advised or co-advised over 80 PhD students. His research interests center on the structure and dynamics of polymer liquids, including solutions, melts, blends, and block copolymers, with particular emphases on self-assembling systems using rheological, scattering and microscopy techniques.

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