# The Australian Society Of Rheology

## 2018 Rheology Seminar Series

CAV Reg. No. A0055806E

## Calendar details

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| Date: | **Monday, 4th June, 2018** |
| Time: | 5:30 PM to 7:00 PM |
| | (Refreshments – 5:00 PM) |
| Venue: | **Monash University** |
| | *#407, New Horizons, Level 4 (click for map)* |

## Seminar talks

**Dr. Laurence Brassart**

*Title: Modelling diffusion coupled to large deformations in soft materials.*

Department of Materials Science and Engineering

Monash University

**Dr. Jeremy Barr**

*Title: Bacteriophage subdiffusion through mucous*

School of Biological Sciences

Monash University

**To help with catering please RSVP by registering for this *free* event.**

* The link can also be accessed manually at
https://www.eventbrite.com.au/e/australian-society-of-rheology-seminar-series-tickets-46315212046

*Enquiries may also be directed to Dr. Prabhakar Ranganathan (prabhakar.ranganathan@monash.edu)*

## Seminar Talk 1

# "Modelling diffusion coupled to large deformations in soft materials"

Abstract:

Hydrogels form an exciting class of soft and smart materials that are being intensively developed for a range of engineering and biomedical applications, from contact lenses and superabsorbent diapers to tissue engineering and drug delivery. Polymeric hydrogels consist of long polymer chains held together by crosslinks to form a three-dimensional network. In general, hydrogels are capable of large deformations mediated by various physical processes, including the elastic stretching of the network, the breaking and reforming of crosslinks, and swelling due to water sorption. In this talk I will present a general continuum-mechanics framework that allow us to model these coupled phenomena in a thermodynamically-consistent way. First, I will discuss the modelling of network elasticity based on the micromechanics of the polymer network. In particular, I will present a novel computational modelling strategy at the mesoscale that allow us to systematically investigate the role of network topology and defects on the stiffness, strength and stretchability of hydrogels. The second part of the talk will focus on the modelling of viscoplastic flow coupled to interdiffusion in physical gels. We show that the coupling can lead to anomalous (non-Fickian) diffusion behaviour.

Laurence Brassart is a Senior Lecturer in the Department of Materials Science and Engineering at Monash University. She graduated from the University of Louvain (UCL, Belgium) with a Diploma in Mechanical Engineering in 2007, and received her PhD from the same university in 2011. She then successively held postdoctoral positions at Harvard University and UCL, before joining Monash in 2015. Dr Brassart's general area of expertise is theoretical and computational solid mechanics, in particular constitutive modelling, micromechanics and the modelling of multiphysics couplings. Her research group at Monash focuses on the mechanics of soft and/or active materials (e.g. hydrogels, complex liquids, energy materials).

## Seminar Talk 2

# Bacteriophage subdiffusion through mucus

Mucosal surfaces are a main entry point for pathogens and the principal site of defence against infection. Both bacteria and bacteriophages (viruses of bacteria) are associated with mucus. We show that phages are increased in mucosal surfaces of animals ranging from corals to humans. *In vitro* studies demonstrate that this increase of phage abundance in mucus occurs via binding interactions between protein domains displayed on the phage capsids and the mucus hydrogel. To investigate this adherence, we used high-speed video microscopy to track diffusion profiles of phages across different mucus concentrations. Phages are inert viral particles that are traditionally thought to be completely dependent on normal diffusion, driven by random Brownian motion, for bacterial host contact and infection. However, we demonstrate that phages display subdiffusive motion in mucus and used experimental and modelling approaches to show that subdiffusive motion increases phage-bacteria encounter rates, which enabled enhanced antimicrobial protection of mucosal surfaces.

Jeremy Barr completed his PhD in microbiology at The University of Queensland in 2011. He then moved to San Diego, USA to complete a postdoctoral position working under the tutelage of Prof. Forest Rohwer at San Diego State University. While there he studied the interactions of bacteriophage with mucosal surfaces and proposed that bacteriophage adhere to mucus model which provides a non-host-derived layer of immunity to all metazoans. In 2016 he joined Monash University's School of Biological Sciences as a lecturer and group leader, his research group studies bacteriophages and their interactions with the human body.