Rheology of fractal colloidal gels

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ABSTRACT: The rheology of complex fluids such as polymer solutions and colloidal materials are intricate functions of the shape, concentration and potential interactions of their constituents. Designing such systems with tailored rheological properties is an open scientific problem. In this talk, we will discuss our ongoing work on rheological control of fractal colloidal gels – a fascinating solid-like material formed out of low volume fraction aggregating colloids. Their elastic rheology is due to their porous, sample-spanning fractal like microstructure. Colloidal gels are widely used to impart quiescent stability to formulations such as paints, agrochemicals and cosmetics. Hence, there is a strong technological driver to produce gels with tailored elasticity using minimal amount of material – a principle we refer to as 'minimal gelation'. In the seminar, we will briefly review state-of-the-art scientific understanding of fractal gel rheology and present two methods towards minimal gelation. The first is through shape anisotropy – we show how oblate spheroids are efficient gelators than spherical colloids and explain why using classical theories of elasticity in percolating networks. Second, we show how doping a gel with a vanishingly small number of active particles can control gel rheology. The studies use 3D confocal microscopy, particle tracking and morphological image analysis in combination with oscillatory rheometry. In the concluding section, we will briefly discuss our work on other soft matter such as biofilms, adhesives and colloidal crystals in light of inverse material design.

Brief Biography – Mahesh Ganesan
Mahesh Ganesan is an Assistant Research Scientist in Chemical Engineering at the University of Michigan in Ann Arbor. He received his PhD in Chemical Engineering and MS in Mathematics at the University of Michigan in 2015. He then worked with Avery Dennison Corporation as a Research Scientist in their Performance Tapes Global Materials Science Group until 2019. His current research interests are in inverse design of soft materials, with focus on anisotropic fractal gels, high loss damping adhesives, biofilm polymers and reconfigurable colloidal crystals.

ALL ARE WELCOME!