

CENTER FOR MOLECULAR & ENGINEERING THERMODYNAMICS SEMINAR



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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

“IMPROVED MODELS FOR COLLOIDAL GELATION: ON THE IMPORTANCE OF HYDRODYNAMIC INTERACTIONS”

Colloidal gels, seemingly frozen dispersions of sticky nanoparticles in a viscous solvent, are among the most abundant soft materials in society. Familiar applications include dairy products and consumer care products, but colloidal gels are also utilized in many industrial applications and find use in novel medical technologies. Despite these burgeoning applications we still lack a fundamental understanding of the physical processes leading to gelation. Discrete element simulations provide one promising means of establishing a link between the intricate microstructure and measurable bulk properties, such as the gel elasticity or its yield stress.

In this talk, we will argue that hydrodynamic interactions (HI) between colloidal particles fundamentally alter the kinetics and importantly, the mechanical properties of colloidal gels. We discuss examples where traditional simulations that neglect HI fail, while a novel parsimonious model accounting for HI, for the first time, successfully recovers known experimental observations. As a specific example we discuss a hydrodynamic instability in sedimenting gels and present a phenomenological model describing the process of network erosion leading to collapse. The model dynamics show good agreement with simulation results and experimental measurements in different gelling systems.

BIOGRAPHY

ZSIGMOND VARGA is a PhD Candidate in the research group of Professor James Swan in the Department of Chemical Engineering at MIT in Cambridge, MA. He received his bachelor's and master's degrees at the University of Cambridge, UK, where he worked on modeling risk and containment scenarios for carbon sequestration and storage. As a graduate student, Zsigmond worked on improving our understanding of the thermodynamics and kinetics of gel networks, which are ubiquitous in our everyday lives. His primary research interests lie in the hydrodynamics of colloidal gelation and the relationship between nonequilibrium microstructures and bulk properties. Recently, Zsigmond's research was recognized with the ACS Langmuir Student Award.



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