

Bioengineering Faculty Search, College of Engineering, University of Toledo

Complex Fluids: Nanomaterial Properties Control Bulk Dynamics

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Complex fluids are everywhere: they include suspensions, emulsions, dispersions, and foams. A few examples in biological systems include blood, liquid pharmaceuticals, and even bacterial biofilms. Regardless of locale, the characteristics and dynamic properties of complex fluids on the macroscopic scale arise from their microstructure and constituent nanoparticle properties. In this talk, I will present an in-depth study of the influence of nanoparticle properties on bulk suspension characteristics. As a case study, we will investigate suspensions of asphaltenes, naturally occurring molecules found in petroleum, which can cause clogging in even the largest pipelines. A combination of various molecular and colloidal scale measurements reveals the fundamentals of asphaltene assembly, nanoparticle surface chemistry, and aggregation dynamics. The aromatic molecular chemistry of asphaltenes, along with trace heteroatoms and metals, imbues asphaltene nanoparticles with surface charge. Given the non-polar nature of the background alkane solvents, these charged moieties readily destabilize, aggregate, and phase separate out of solution. At the same time, understanding the nano- and micro-scale characteristics of asphaltenes allows us to control macroscale suspension dynamics using surfactant additives. In particular, we will see how colloidal growth and aggregation influences macroscopic dynamics of sedimentation and deposition in flow. We will discuss extensions of the principle “microscale properties determine macroscale dynamics” to specific problems in bioengineering.

Where: SSOE Seminar Room, NI 1027

When: Friday, September 1, 2017

Time: 11:30 – 12:30 pm

Sara Hashmi obtained her A.B. in Physics in 2001 from Harvard University, followed by a M.S. in 2004 and a Ph.D. in 2008, both in Chemical Engineering from Yale University. She was an NSF Graduate Fellowship recipient for her doctoral research. She then continued her research in the Chemical & Environmental Engineering Department at Yale as a postdoctoral fellow and as a research associate. During these years Dr. Hashmi was also a lecturer teaching classes in chemical engineering and materials science. In 2014, she was appointed to her current position of Director of the Light Scattering Facility at the School of Engineering and Applied Science at Yale. Dr. Hashmi has continued her research in the fields of complex fluids and light scattering. She has over 30 peer-reviewed journal publications and has presented at numerous invited and contributed talks at conferences and institutions.