The Rheology of Colloidal & Nanoparticle Dispersions: "STF Armor"-Nanoparticle Composites for Flexible Ballistic Materials

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Colloidal and nanoparticle dispersions can exhibit shear thickening, which is an active area of research with consequences in the materials and chemical industries, as well as an opportunity to engineer novel energy adsorbing materials. A fundamental understanding of shear thickening has been achieved through a combination of model system synthesis, rheological, rheo-optical and rheo-SANS and now, flow USANS measurements, as well as simulation and theory.

Novel ballistic, stab and impact resistant flexible composite materials are synthesized from colloidal & nanoparticle shear thickening fluids (STFs). Through ballistic, stab & laboratory testing, the mechanism of energy adsorption at ballistic rates is demonstrated to result from reversible shear thickening. As a basis for the rational design of flexible ballistic & stab resistant materials, we report a rheological and microstructural investigation of the high shear rheology of colloidal and nanoparticles dispersions. Control of particle size, size distribution, shape, surface and bulk properties is shown to be critical to performance. Statistical mechanical modeling provides a framework for the rational design of materials to meet specific threats. Potential applications of these dispersions as novel energy absorbing materials are discussed, including commercial body armor.

FRIDAY, November 16, 2007
2:00 – 3:00 p.m.
BOGGS ROOM 122
Refreshments will be served before the seminar.