PURDUE UNIVERSITY

PURDUE MATERIALS ENGINEERING

Shear Thickening of Chemical Mechanical Polishing Slurries

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9:15 am Coffee
9:30 am Seminar
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Numerous YouTube videos show people walking on "water". This "water" is a mixture of corn starch and water that exhibits a phenomenon known as shear thickening. The viscosity of shear thickening fluids dramatically increases upon reaching a critical stress (e.g., when a human foot contacts the fluid), but behaves like a liquid below the thickening threshold. Chemical mechanical polishing (CMP) slurries also exhibit shear thickening. CMP is a fundamental technology used in the semiconductor manufacturing industry to polish and planarize a wide range of materials for the fabrication of microelectronic devices (i.e., computer chips). During the high shear polishing process, it is hypothesized that individual slurry particles (~100 nm) collide with one another to form large agglomerates (>500 nm) that cause the slurry to shear thicken. These agglomerates tend to dig into the material surface triggering defects such as scratches or gouges during polishing (costing the semiconductor industry billions of dollars in lost production annually). The project's goal is to understand the high shear rheological behavior of CMP slurries and to link changes in particle structure, both temporary and permanent, to the observed shear thickening response.

Matthew W. Liberatore is as an Associate Professor in the Department of Chemical and Biological Engineering at the Colorado School of Mines. He earned a B.S. degree from the University of Illinois at Chicago and M.S. and Ph.D. degrees from the University of Illinois at Urbana-Champaign, all in chemical engineering. His current research involves the rheology of complex fluids especially traditional and renewable energy fluids and materials, polymers, and colloids. His teaching interests include developing problems from YouTube videos as well as active and self-directed learning such as personalized online homework.