



MECHANICAL ENGINEERING SEMINAR

Research Innovations in Particle-Augmented Mixed Lubrication

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The primary focus of this talk involves the multi-physics modeling and experimental approach that has been developed in order to analyze a manufacturing process known as chemical mechanical polishing (CMP). CMP has emerged as a commonly used method for planarizing micro-scale and nano-scale systems, such as integrated circuits and hard disk read/write heads, during their fabrication process. During CMP, the wafer that contains the device is mounted onto a rotating carrier and pressed against a rotating polyurethane pad that is flooded with slurry, which causes the surface of the device to be polished to a smooth level. Although CMP is commonly practiced in industry, much of the phenomena behind CMP are unpredictable and not understood due to the complex interplay of the slurry fluid motion and the interactions between the wafer, pad, and abrasive particles. In order to gain insight into the CMP process and to develop a reliable first-principle model for CMP, a generalized multi-physics modeling approach known as the Particle Augmented Mixed Lubrication (PAML) model was developed and validated with experiments in this study. The PAML modeling simulation combined models for the slurry fluid flow, the abrasive particle motion, the contact mechanics between the wafer and pad surfaces, and the material wear.

Most recently, the PAML modeling approach has also been used to model other multi-phase tribological (sliding contact) systems, including a multi-phase journal bearing, an artificial hip joint with embedded wear particles, and a hard disk drive with entrained contaminants. In addition to providing an overview of these additional research thrusts, this talk also presents future research possibilities that can be spawned from this work.



Dr. Elon J. Terrell is a post-doctoral researcher in the Mechanical Engineering Department of Carnegie Mellon University in Pittsburgh, PA. Originally from Dallas, TX, he received his B.S. and M.S. degrees at the University of Texas at Austin in 2002 and 2004, respectively, both in Mechanical Engineering. He received his Ph.D. from Carnegie Mellon University in August 2007, also in Mechanical Engineering. His research interests primarily involve the thermal-fluid sciences, and branch into the energy, tribology, contact mechanics, and material science fields.

Thursday, APRIL 3, 2008

12:00 pm Seminar in 233 Mudd

1:00 pm Lunch in ME Lobby