Mechanical Engineering **SEMINAR**

Quantification of chemical forces with picometer resolution using three-dimensional atomic force microscopy

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Site-specific surface chemical interactions govern numerous scientific and technological fields including catalysis, thin film growth, and tribology. Full control over design processes in these fields requires quantitative, site-specific elaboration of the surface force field. Until now, such information has only been theoretically accessible. In this talk, we present an atomic force microscopy-based approach to experimentally obtain this data and illustrate its application by imaging the three-dimensional surface force field of graphite.

Graphite has been chosen due to its importance as a solid lubricant as well as model system for multilayer graphene. We show force maps with picometer and piconewton resolution that allow a detailed characterization of the distance-dependent surface-probe interactions vertically as well as laterally. Within these maps, the positions of all atoms are identified, and differences between atoms at inequivalent sites are quantified. The results suggest that the origin of graphite's excellent lubrication properties may lay in a remarkable localization of the lateral forces. Future applications of this method in areas such as chemical imaging and surface catalysis are envisioned.

Udo D. Schwarz graduated in 1989 from the University of Basel, Switzerland, receiving his Ph.D. in physics from the same institution in 1993. Subsequently, he continued his work as a staff scientist and lecturer at the Institute of Applied Physics of the University of Hamburg, Germany. In 2001, Prof. Schwarz moved to the Materials Science Department of the Lawrence Berkeley National Laboratory in Berkeley, California. Since mid-2002, he works as an associate professor at Yale's Mechanical Engineering Department. His research interests are in nanomechanics, nanotribology, and the local measurement of atomic-scale interactions including high-resolution atomic-scale imaging. More specifically, he uses scanning probe microscopy techniques (predominantly scanning force microscopy) to study problems in surface physics, catalysis, friction, adhesion, and the physics of dielectrics, semiconductors, and metals.

Thursday, April 23, 2009
11:00-12:00pm Room 233 Mudd
Lunch served at 12:00pm in ME lobby