

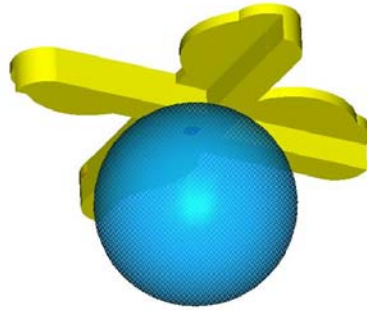
# Mechanical Engineering Fall 2006 Seminars

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224 MEC

## Microscale Transport Phenomena in the Presence of Interfaces

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### ABSTRACT

Drops and bubbles share the same interesting feature: the smaller they are, the more free surface effects dominate over bulk effects. The first part of the talk is focused on the impact of a microdroplet on a solid substrate, a problem of interest for microelectronics packaging and micro-cooling solutions. For applications using droplets with diameters of a couple of micrometers, the fluid flow and heat transfer depend strongly on interfacial phenomena. We present a high resolution laser measurement system to measure transient, local temperatures at the interface between a substrate and an impacting droplet. Our strategy is to compare laser temperature measurements with Finite-Element simulations and high-speed visualization: this will allow the investigation of process and material parameters controlling interfacial heat transfer. A second part of the talk presents theoretical and experimental results about bubbles passing through a microchannel contraction, a problem of interest for microfluidics systems. We show how interfacial phenomena control the pressure drop and identify strategies to prevent bubbles to clog microchannels. Finally we present experiments involving bubble *microstreaming* (a shear flow created in the immediate vicinity of an oscillating microbubble). We show how this very local velocity field can be controlled to manipulate biological cells or to power a micro-rotor at a speed of 500 revolutions per minute.

### BIOGRAPHY

Daniel Attinger received his Ph.D. in technical sciences from ETH Zurich, Switzerland, in 2000, and worked then on microfluidics systems in the start-up company Seyonic SA. In 2002, he became an assistant professor at the State University of New York at Stony Brook. Since 2005, he is an assistant professor at the Mechanical Engineering Department of Columbia University. His research is in transient transport phenomena at the microscale, with a special interest in problems involving a single microdroplet, bubble or sphere. Applications are in the areas of MEMS manufacturing, bioengineering, microscale heat management and microfluidics. Dr. Attinger is a member of the American Society of Mechanical Engineers and the Association for Laboratory Automation. He is the recipient of the ETH Zurich Silver Medal and an NSF CAREER award.