

George R. Brown School of Engineering
Department of Chemical & Biomolecular Engineering

Presents

Professor Matteo Pasquali

Departments of Chemical & Biomolecular Engineering & Chemistry,
The Smalley Institute for Nanoscale Science & Technology,
The Ken Kennedy Institute for Information Technology
RICE UNIVERSITY

Thursday, October 23, 2008 – 2:30 p.m.

McMurtry Auditorium - Duncan Hall

Reception to follow in Abercrombie B237



“Carbon nanotubes fluids: simple or complex?”

At the single-molecule level, Single-Walled Carbon Nanotubes (SWNTs) have remarkable electrical and mechanical properties, more so than previously known polymer molecules or colloidal particles. Realizing these properties in applications requires understanding and controlling the behavior of SWNTs in fluid phases. Biological and environmental applications as well as sensors are likely to require dilute phases of SWNTs; material processing, e.g., production of coatings and fibers, will require more concentrated phases. After the achievement of scalable production in the late 1990s, fluid handling became the most important frontier of applied SWNT research. To some extent, SWNT liquids were (and still are) considered an oxymoron because dispersing or dissolving SWNTs into fluid phases proved exceedingly difficult. “In this lecture, I will discuss how SWNTs can and should be viewed as hybrids between polymer molecules and colloidal particles. Even at low concentrations (few parts per million), SWNTs form complex fluid phases with intriguing properties. When stabilized properly, dilute SWNTs behave as Brownian rods. Their interaction can be mediated by polymers and surfactants to produce complex individual architectures, or to devise scalable methods for making transparent conductive coatings. In superacids, SWNTs dissolve spontaneously. At sufficiently high concentrations, they form liquid crystals that can be spun into well-aligned, macroscopic fibers. Intriguingly, the self-assembly of SWNTs into liquid crystalline phases can be understood by “hybridizing” Onsager’s theory for colloidal rods with Flory’s theory for rod-like polymers.”

ABOUT THE SPEAKER

Prof. Matteo Pasquali has been at Rice University since 2000, where he is currently a Professor of Chemical & Biomolecular Engineering and Chemistry. He directs a laboratory working on complex and nanostructured fluids. Before joining Rice, Prof. Pasquali earned a PhD in Chemical Engineering at the University of Minnesota, with a thesis on modeling of free surface flows of polymer solutions, and worked as a postdoc on the dynamics of semiflexible polymers. Prof. Pasquali’s research interests revolve around understanding the interaction of flow and micro-structure in complex fluids, with application to the processing of multifunctional materials, particularly those based on Single-Walled Carbon Nanotubes (SWNTs). Specific problems of interest include: dispersion and liquid crystalline behavior of SWNTs in superacids; spinning of SWNT fibers; coating of transparent, conductive SWNTs films; behavior of individual SWNTs in liquids; entrapment of SWNTs into biocompatible micelles; behavior of SWNTs in confined environments; interaction of flow with flexible and semiflexible molecules; mechanics of blood cells to understand and control hemolysis in blood pumps; modeling complex flows of complex fluids across length scales. Prof. Pasquali co-directed the Rice Carbon Nanotechnology Laboratory from 2005 to 2008.