

**CENTER FOR FLUID MECHANICS
AND
THE FLUIDS, THERMAL AND CHEMICAL PROCESSES GROUP
OF
THE DIVISION OF ENGINEERING
SEMINAR SERIES**

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**Synthesis, Functionalization and Applications of Compound Semiconductor
Nanocrystals**

Nanocrystals or “quantum dots” of compound semiconductors (e.g. CdSe, ZnSe, CdS, PbSe, etc.) that confine electron-hole pairs (excitons) in zero dimensions are attracting a lot of attention because of their unique size-dependent properties and their potential to revolutionize clinical diagnostics, photovoltaics, and high-density optoelectronics.

This presentation will focus on process engineering issues related to the synthesis and functionalization of ZnSe nanocrystals. Two new synthesis techniques have been developed in our laboratory offering distinct advantages for large-scale production of these materials:

(a) Microemulsion-gas contacting: This technique exploits the dispersed phase of self-assembled microemulsions and liquid crystals to form numerous identical nanoreactors producing almost monodisperse nanocrystal populations. Recent results on templated growth nanowires, nanorods and free-standing quantum wells in liquid crystals will also be discussed.

(b) Vapor-phase synthesis in a counterflow jet reactor: This technique is compatible with the existing infrastructure of the microelectronics industry and produces nanocrystals with superior purity.

Studies of the fundamental links between transport phenomena, reaction kinetics, particle nucleation, cluster coalescence, and nanocrystal properties are being performed in order to identify optimal synthesis conditions. We employ a combination of experiments and multi-scale process models to probe the underlying phenomena. Surface passivation and functionalization protocols have been developed to exploit the size-dependent luminescence of the nanocrystals in novel multiplexed biosensors and DNA arrays. A procedure for conjugating nanocrystals with oligonucleotides in water will be discussed that results in significant amplification of their luminescence intensity. Applications of these materials in clinical diagnostics will be outlined.

**TUESDAY – OCTOBER 11, 2005
Barus & Holley, Room 190
3:00pm**