

# UNH Materials Science Seminar

11:10-12:00, Thursday, October 2, 2008

DeMeritt Hall 238

University of New Hampshire

## Compositional and morphological patterning in quantum dots and nanowires

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Knowledge of composition profiles within self-assembled SiGe and InGaAs quantum dots and nanowires is critical for applications in optoelectronic and memory devices as variations in composition at the nanoscale can substantially influence their electronic properties. Obtaining the quantitative description of composition profiles in a quantum dot is a challenging task due to the coupling between composition variations, shape of the quantum dots and long-range elastic interactions. In this talk, we present an efficient scheme that combines the finite element analysis with an optimization scheme based on a quadratic programming method to determine equilibrium profiles in strained quantum dots and nanowires [1]. Composition profiles are found to strongly depend on the shape of the quantum dots, as strain relaxation in dots with steeper sidewalls allows for segregation of the larger alloy component in the regions near the apex. Based on these observations, we have developed a phase diagram that shows the degree of segregation of the alloy components in the phase space spanned by the temperature (which governs chemical mixing) and the shape of the dot. Further, we find that the segregation of the alloy components can substantially reduce the critical dot size for the transition between the shapes with different facets. Dynamics of surface evolution leading to spontaneous compositional patterning in these systems is also discussed [2].

[1] N. V. Medhekar, V. Hegadekatte and V. B. Shenoy, PHYS REV LETT, 100, 106104 (2008).

[2] V. B. Shenoy, W.L. Chan and E. Chason, PHYS REV LETT, 98, 256101 (2007).

**Vivek Shenoy** received his Ph.D. from the Ohio State University in 1998, working with Will Saam and Jason Ho. From 1998 to 2000 he was a postdoctoral fellow at Brown University with Rob Phillips. In 2000 he became an Assistant Professor of Engineering at Brown University and was promoted to the rank of Associate Professor in 2005. He held the Richard and Edna Solomon Assistant Professorship from 2002-2005 and is a recipient of the Rosenbaum visiting Fellowship from the Isaac Newton Institute of Mathematical Sciences, University of Cambridge. In 2006 he spent his sabbatical leave at the California Institute of Technology and the IBM Watson Research Center.

Host: Professor Karsten Pohl x4197