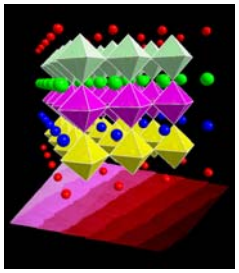
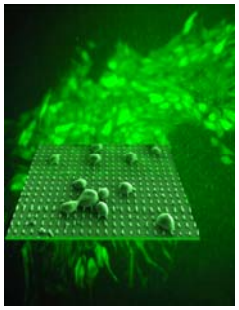
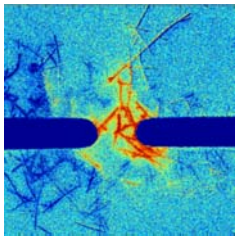
CNMS DISCOVERY SEMINAR SERIES

Friday, May 1, 2009
11:00 am
Iran Thomas Auditorium, 8600







"The Localization Model of Rubber Elasticity"

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Abstract:
While the singular elastic properties of rubbery polymer materials have been studied for literally centuries, a quantitative theoretical description of these properties in terms of molecular structural parameters remains a challenging task. Classical network elasticity theories are based on the conception of flexible volumeless network chains fixed into a network in which there are no excluded volume interactions between the chains and where the chains explore accessible configurations by thermal fluctuations. The shortcoming of this approach is clear from the observation that unswollen rubbery materials are nearly incompressible, reflecting the existence of strong intermolecular interactions that restrict the polymer chains to an exploration of their local molecular environments. The imposition of a deformation of these solid rubbery materials then necessitates a consideration of how local molecular packing constraints become modified under deformation and the impact of these changes on the macroscopic elasticity of the material as a whole. Many researchers have struggled with this difficult problem, but we focus on the simple 'localization model' of rubber elasticity introduced by Gaylord and Douglas (GD), which provides an attractive and mathematically simple minimal model for the network elasticity of rubbers having strong intermolecular interactions in the dense polymer state. The properties of this model are summarized and the model compared to observations on rubbery materials where both the cross-linking density and swelling are varied.

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Center for Nanophase Materials Sciences