



PAUL SCHERRER INSTITUT

Extra Photon Science Seminar

Polymer mechanics at the nanoscale

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DATE: Monday, September 14, 2015
TIME: 11:00
ROOM: WBGB/019

Abstract

Point probe methods such as nano-indentation and AFM are very widely used to determine local elastic, inelastic and time dependent properties. Simple scaling shows why these methods have, perhaps surprisingly, proved more useful than macro-scale contact testing. However, they only give averaged constitutive properties (modulus, hardness etc.) from the very wide range of strain states present. Despite much effort it has remained difficult to extract stress-strain relations.

This talk will introduce a flat punch method for thin polymer films that gives stress-strain behaviour from a homogeneous field. Examples will be shown of normal polymer behaviour, and also where properties diverge at the nanoscale and some of the usual scalings break down. We find that permanent plasticity is accommodated by a remarkably large densification, of several percent, which is well above that of typical thermal aging or relaxation, and which remains stable after removal of the applied stresses. Pure hydrostatic pressure does not have this effect. It requires shear flow, with implications for the deformation mechanisms of many inhomogeneous and free volume materials, and for imprint lithography.

The talk will conclude by discussing some developments in the governance and structures at NPL and at CRANN, including those to facilitate collaborations with industrial research.

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