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Rheo-XPCS studies of collective dynamics and mechanical evolution in soft nanostructured materials

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This talk discusses x-ray photon correlation spectroscopy under shear (Rheo-XPCS) as a method for studying the behaviour of soft nanostructured materials in response to applied deformation. In XPCS, the characteristic “speckle” patterns resulting from the scattering of coherent x-rays are auto-correlated to uncover collective dynamics in a sample. XPCS can currently be used to study the dynamical behavior of non-ergodic materials on the nanoscale over a wide range of time scales (from 10^{-3} - 10^3 s). Here we present studies of a set of soft disordered solids (concentrated nano-colloidal gels, nano-emulsions and clay suspensions) subjected to in-situ shear strain that provide insight into particle rearrangements at the nanometer scale and their connection to dynamical and mechanical behaviour of the materials. These studies illustrate a range of fascinating phenomena, including shear-induced rejuvenation and over-aging, mechanical training by large amplitude oscillatory strain, and nanoplasticity, that will be discussed.

Primary authors: Prof. HARDEN, James L. (University of Ottawa); Prof. ROGERS, Michael C. (University of Ottawa); Prof. LEHENY, Robert L. (Johns Hopkins University)

Presenter: Prof. HARDEN, James L. (University of Ottawa)

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