

Quantitative in-situ neutron imaging of non-equilibrium soft and complex matter systems using cold neutrons

Wednesday, 18 April 2012 09:00 (30 minutes)

The movement of solvents in and through soft and complex matter is not only of fundamental interest but is also important for applications as wide-ranging as drug-delivery, food packaging, oil recovery and water uptake in plants. Solvent flux results in changes in the local composition of a material which can be measured using neutron imaging. The concentration profiles extracted from the images can yield fundamental details about the diffusion behaviour of the solvent. By deuterating one component, e.g. the solvent, and using cold neutrons, the neutron contrast in the sample can be improved significantly. Together with the recent technical improvements in neutron imaging instrumentation, especially the scintillators used, this allows quantitative in-situ measurements on such systems with a resolution of a few tens of micrometers and seconds. In this presentation I will give an overview of our results from the neutron radiography instruments ICON (PSI) and ANTARES (FRMII) and describe a few examples from the wide range of samples we have investigated to date. These include biologically-relevant systems, nanoporous materials, amphiphiles and polymers. I will also present details of the practical considerations specific to our systems and the consequences for instrument design such as suitable neutron wavelength distributions, beam intensities and camera-scintillator combinations.

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Session Classification: Water transport I