KN02 | New Experimental Techniques For Exploring Crystallization Pathways And Structural Properties Of Solids

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The lecture will highlight two experimental strategies that we are developing, specifically: (i) *in-situ* solid-state NMR techniques for monitoring the time-evolution of crystallization processes, and (ii) X-ray Birefringence Imaging, a new technique that allows the distribution of molecular orientations in anisotropic materials to be mapped in a spatially resolved manner.

Our *in-situ* solid-state NMR techniques for studying crystallization pathways exploit the ability of NMR to *selectively* detect the solid phase in heterogeneous solid/liquid systems of the type that exist during crystallization from solution. This strategy allows the sequence of solid phases formed during crystallization to be established, including the discovery of new transient polymorphs. A recent development is an *in-situ* NMR strategy (called "CLASSIC NMR") that yields simultaneous information on the time-evolution of *both* the solid phase *and* the liquid phase during crystallization. This strategy extends the scope and capability of *in-situ* NMR for gaining insights into the evolution of crystallization processes.

Following our early studies of X-ray birefringence in solids, we reported in 2014 an experimental set-up that allows spatially resolved measurements of X-ray birefringence to be carried out in "imaging mode". In many respects, this technique (called X-ray Birefringence Imaging) is the X-ray analogue of the polarizing optical microscope. The lecture will describe several applications of this technique, demonstrating the utility of X-ray Birefringence Imaging for characterizing changes in molecular orientations associated with solid-state phase transitions, determining the size and spatial distribution of domain structures in materials, and establishing molecular orientational ordering in anisotropic materials, including liquid crystals.