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Report:

X-ray Photon Correlation Spectroscopy of Dynamics in Thermosensitive Gels

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Summary: Temperature-sensitive hydrogels undergo a volume phase transition (VPT) when heated above a critical temperature T_c. For the poly(N-isopropyl acrylamide) (PNIPA)-water system, T_c.= 34°C. Below T_c the gels are transparent and highly swollen. On warming above T_c they promptly turn white and start to deswell. The rate of deswelling, however, can be orders of magnitude slower than that of swelling below T_c. The unstable intermediate structure above T_c, can retain the solvent and conserve the sample volume for may days, even with millimetre-sized samples.

Light scattering observations of the internal structure of these gels above T_c are precluded by their strong turbidity. Small angle X-ray scattering measurements (SAXS), on the other hand, are less subject to multiple scattering as X-rays penetrate more easily into the bulk material. Conventional (incoherent) SAXS observations reveal intense scattering from smooth internal water-polymer interfaces with an estimated surface area of about 7 m^2/g in the swollen gel. The dynamics in the off-equilibrium high temperature state, investigated by X-ray photon correlation spectroscopy (XPCS), displays a relaxation rate that is linearly proportional to the wavevector q, rather than to q^2 as in diffusion processes. The physical origin of this relaxation is consistent with *jamming*, a phenomenon that is common in other disordered systems.

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