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Phase transition kinetics in a doubly thermo-responsive block copolymer thin film

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Thermo-responsive polymers respond to small changes in temperature with a drastic change in their conformation, which makes them promising candidates for manifold application fields. While the underlying mechanisms of such polymers in solution are well understood, less is known about thermo-responsive polymers in thin film morphology. In our recent work, we follow the phase transition kinetics upon increasing temperature in-situ in a doubly thermo-responsive block copolymer thin film. The block copolymer consists of a poly(N-isopropylmethacrylamide) (PNIPMAM) block, which shows a lower critical solution temperature (LCST) and a zwitterionic poly(sulfobetaine) (PSPP) block, which exhibits an upper critical solution temperature (UCST) that is lower than the corresponding LCST of the PNIPMAM block. At temperatures below the UCST, the polymer film is swollen in D₂O atmosphere in order to increase the mobility of the polymer chains. Subsequent, temperature is increased to an intermediate regime (between UCST and LCST) and high regime (above LCST). The kinetic processes (swelling and temperature jumps) are followed with via time-of-flight neutron reflectometry (TOF-NR) with high time resolution. Static TOF-NR measurements and TOF grazing incidence small angle neutron scattering (GISANS) measurements are performed at the beginning and in between the kinetic processes to gain a complete picture of the swelling and temperature-dependent behavior of the polymer thin film.

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