Small Angle Neutron Scattering Study of Micellar Transitions in Pluronic 17R4

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Poly(propylene oxide)$_{14}$-poly(ethylene oxide)$_{24}$-poly(propylene oxide)$_{14}$ (Pluronic 17R4) in D_2O was studied by small angle neutron scattering (SANS) techniques. The reported[1,2] phase diagram of 17R4 in H_2O was used as a preliminary phase diagram for the 17R4 in D_2O system. Like the 17R4/H_2O system, the phase diagram of the 17R4/D_2O system displays three distinct regions: (1) an opaque, cloudy one-phase region, (2) a clear, one-phase region, and (3) a two-phase region which exists above a lower critical solution temperature (LCST). In our investigation, SANS was used to elucidate the shape and form taken by 17R4 in each of these regions in the D_2O system. Neutron scattering within the cloudy "unimer" region suggests that the polymers are not behaving as typical unimer molecules, free in solution. A strong scattering intensity at low wave vector Q suggests a clustering of the polymer, while relatively low scattering intensities at the mid- to high-Q range suggest a lack of micelles in solution. It is plausible that the polymer molecules are not free as unimers in solution, but rather are clustered to form a net-like structure. As the solution is heated, these networks break, and the solution clears. Scattering in this clear one-phase region suggests the formation of micelles. Scattering measurements in each phase above the LCST were also taken.

[1] Zhou, Z; Chu, B. Macromolecules 1994, 27, 2025.
[2] Jacobs, D.T.; Patton, K. Unpublished work, 2008.