Attractive interactions of PEO-containing block copolymer micelles in salt solutions

Manja Behrens¹*, Cristiano L.P. Oliveira¹ and Jan Skov Pedersen¹

¹Department of Chemistry and iNANO Interdisciplinary Nanoscience Center,
University of Aarhus, Denmark
*e-mail: mab@phys.au.dk

A Block copolymer comprised of a hydrophobic block and poly(ethylene oxide) (PEO) have shown to be a good model system for self-assembly studies. PEO is chemically the simplest water soluble polymer as well as the simplest bio-compatible polymer, not recognizable by the human immune system and it has therefore also been widely studied. PEO-containing block copolymers can form spherical micelles in water when linked to a short hydrophobic tail [1,2]. In the current project the attractive interactions of the micelles formed by the block copolymer surfactant Brij 700 is studied. This polymeric surfactant system is composed of about 100 ethylene oxide units with a hydrophobic tail of a C₁₈ alkyl chain. For pure water, the cloud point is around 100°C, however, the addition of 0.9 M NaF or 0.7 M MgSO₄ lowers the cloud point sufficiently to enable the study of both the repulsive and attractive intermicellar interactions at experimentally obtainable temperatures. The block copolymer systems have been studied as a function of temperature by turbidometry, viscometry, densiometry, and small-angle X-ray scattering (SAXS). The densiometry revealed a steep decrease in the apparent specific volume at low temperatures, further clear changes are also evident in SAXS data. The SAXS measurements have been performed on concentration and temperature gradients of the block copolymer systems and have provided information on the structure of the micelles and the temperature dependence of the intermicellar interactions. In viscosity it is evident that the interparticle interaction decreases with increasing temperature corresponding to the decrease observed in the hard sphere radius and the hard sphere volume fraction found by modeling of the SAXS data. Further from the SAXS data a decrease in the overall size of the micelles are also observed with increasing temperature.