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Properties of self-assembled gels formed by crosslinked hydrophilic polymer and surfactant wormlike micelles

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One of the most critical properties of surfactant molecules is the ability to self-assemble due to weak non-covalent interactions into micelles, which may have different shapes. Example of such aggregates is long wormlike micelles which interlace and form a network of topological entanglements, which gives viscoelastic properties to the solutions. Mechanical properties of such gels are not always high; but they can be increased by adding a polymer. As a result, a double network of wormlike micelles and polymer chains is formed. Such polymer-surfactant networks may find application in oil recovery as a thickening agent for hydraulic fracturing fluids. The aim of this work is to study the structure and responsive properties of the systems containing mixed anionic/cationic wormlike micelles and hydrophilic polymer.
Firstly, it was shown that the polymer single network, as well as the micellar single network, is sensitive to the change of pH. Moreover, for these networks, the pH values at which there is a drop in mechanical properties (viscosity and elastic modulus) almost coincide. However, double networks at the same pH value have high mechanical properties. It is explained by the fact that the wormlike micellar network inside the double network breaks up with the formation of vesicles (as evidenced by SANS). These vesicles stabilize the cross-links between polymer chains (by electrostatic interaction), and the polymer network does not break up. Complete loss of mechanical properties for double networks occurs at a pH value that is significantly lower than for each of the networks separately.
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