Effect of Corona Chain Lengths on Micelle Packing in Hydrogels Formed by Binary-Pluronic Copolymers

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In this study, we concentrated on the influence of corona chain lengths of mixed micelles on gelation behaviors. The biomaterial we used is the binary-Pluronic amphiphilic copolymers F108 and P123 due to its wide application on clinical treatment. Macroscopic gelation behavior of Pluronic F108, F108+P123 (2:1wt%) and F108+P123 (1:1wt%) were investigated firstly through tube inversion method and rheometry from 10 - 90 °C and 10 – 36 wt%. It is found that hard gel region in the phase diagram increases initially and then decreases while consecutively enhancing the ratio of P123. Correlating the macroscopic behavior to the microscopic structure of hydrogel through the SAXS experiments, it is found that all the systems exhibit body-centered cubic (BCC) structures in equilibrium state except system F108+P123 (2:1 mass ratio), where face-centered cubic (FCC) and BCC structures co-dominate the system. Corona region of micelles is compressed during packing and the entanglement density between corona chains of neighbored micelles decreases with increasing P123 ratio of the system. The more uniform the corona chain lengths, the stiffer the hydrogel. However, mixed micelles with non-uniform corona chain lengths (F108+P123 at 2:1 mass ratio) provides more space for neighbored micelles enhancing the possibility of chain tethering and promoting hydrogel formation. Therefore, hydrogel formation and stiffness of the material could be easily adjusted by the corona chain lengths of micelles.