Anomalous formation of the rectangular phase by the $G_mBO_nG_m$-type triblock copolymer

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Amphiphilic block copolymers have characteristics such as a wide range of HLB, low toxicity and low cmc. Therefore they are widely used in many fields including pharmaceuticals, cosmetics and foods. While a poly(oxyethylene) chain is generally used as a hydrophilic group, we used a polyglycerol chain. Since glycerol is a by-product from soap and biodiesel production, it is important to utilize it effectively. In this paper, we report anomalous formation of the rectangular phase by $G_mBO_nG_m$-type triblock copolymer (Fig. 1) in a wide composition range.

In the branched type/water system, the optical anisotropic liquid crystal was formed in the concentration range, 50-80 wt%, and two phase equilibrium of the liquid crystalline phase and the water phase was observed below 40 wt% (Fig. 2). By above-mentioned phase behavior and small-angle X-ray scattering (SAXS) results, we characterized the liquid crystalline phase as the reverse rectangular (R_2) phase. To the best of our knowledge, the R_2 phase formation in such a wide range of composition is not known. In addition, we found that the lattice long side of the R_2 phase was elongated while the short side was kept almost constant with increasing the water content. On the other hand, in the linear type/water system, the range of the R_2 phase was shrunk. Furthermore, positively curved spherical micelle (W_m) and lamellar liquid crystal (L_α) were also formed. Thus, these data suggest that the branched type is more hydrophobic than the linear type.

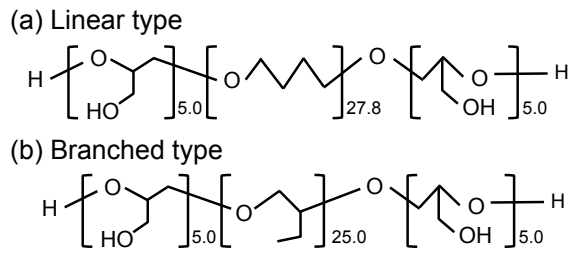

Figure 1 Molecular structures of $G_mBO_nG_m$

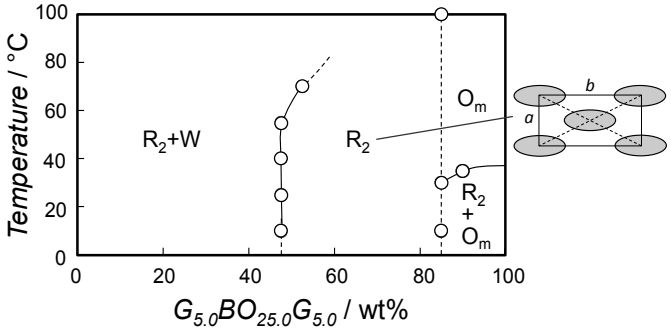

Figure 2 The Phase diagram of the $G_{5.0}BO_{25.0}G_{5.0}$(Branched type)/water system