New Self-Assembled Structures from Highly Complex Polymeric Systems

Yushu Matsushita

Graduate School of Engineering, Nagoya University

Block and graft polymers are known to form complex but periodic self-assembled structures in concentrated solutions or in bulk. Highly-complex but ordered structures formed by two kinds of terpolymers are compared focusing on the difference in chain connectivity.

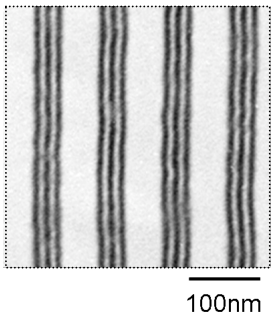

Figure 1. Hierarchically ordered lamellar structure from an undecablock terpolymer

The first one is composed of two kinds of multiblock terpolymers with different chain lengths, i.e., hexablock terpolymers of the PISISI type and undecablock terpolymers of the PISISISIISP type, where I, S and P denote polyisoprene, polystyrene and poly(2-vinylpyridine), respectively. Composition dependence of the morphological variation was studied for two series and it has been found that several hierarchically periodic structures having two repeating distance have been observed. Among them, Figure 1 shows lamellar structures from undecablock terpolymers with ϕ_P of 0.52. The larger spacing consists of thick P lamella and five thin I-S-I-S-I lamellae [1].

The second one is I-S-P star-branched terpolymer whose three polymer chains are connected at one junction point, therefore, cylinder-based structures are likely to be formed. Their cross sections reveal periodic two dimensional tilings, most of them were characterized as the Archimedean tilings[2]. Furthermore, we have found aperiodic but highly ordered tiling pattern which show dodecagonal symmetry in x-ray diffraction experiment [3]. The length of the elements, i.e., triangles and squares was measured to be ca. 50nm, it being scaled-up size comparing with those of dodecagonal quasicrystals ever known for the other materials.

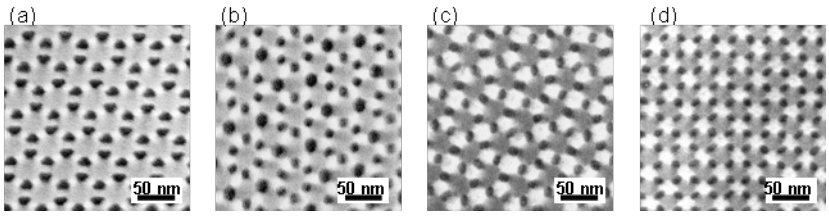

Figure 2 Morphologies of a series of $I_{1.0}S_XP_{2.0}$. X values are a)1.3, b)1.8, c)2.3, d) 2.7.

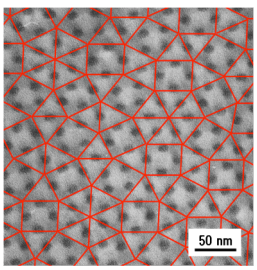

Figure3. DQC structure from $I_{1.0}S_{2.7}P_{2.5}$

References 1)J.Masuda *et al. Phys.Rev.Lett.* **97**,098301(2006). 2) K.Hayashida *et al. Macromolecules* **39**, 9402 (2006). 3) K.Hayashida *et al. Phys. Rev. Lett. ,* **98**, 195502 (2007).