Mesoscopic Archimedean Tilings in Polymeric Stars

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Four mesoscopic Archimedean tiling patterns have been observed for the molten ABC star-branched terpolymers composed of polystyrene(S), polyisoprene(I), and poly(2-vinylpyridine)(P) of the type $S_{1.0}I_{1.0}P_x$. The copolymers exhibit (6^3), (4.8^2) and (4.6.12) Archimedean tiling[1] when x are 0.7, 1.2 and 1.9[2], respectively, while the molecule of the type $S_{1.0}I_{1.0}P_{1.3}$ shows more complex (3^2.4.3.4) tiling pattern with mesoscopic length-scale. Namely the side length of the polygons are about 80nm. In this structure the circumstance of a molecule splits into multiple sites and consequently two microdomains with different sizes and shapes are formed for one component. Moreover the experimental results were well explained with the predicted results based on free energy theorem using Monte Carlo method. This pattern has been observed for the other materials on much shorter length-scale, therefore, the experimental fact observed in the present study is demonstrating that the complexity is universal over different hierarchy.

[1] Grunbaum B., Shephard G. C., *Tilings and Patterns,* Freeman, New York, 1986.[2] Takano A., Matsushita Y. et al., *Macromolecules*, 2004, **37**, 9941.

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