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Self-Assembly of Block Copolymers - from Periodic to Aperiodic Structures

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Block copolymers with incompatible components are known to self-assemble into regular structures with mesoscopic length scales. This paper introduces periodic and aperiodic tiling structures from two kinds of three component terpolymer systems. One includes binary blends of linear poly(isoprene-styrene-2-vinylpyridine)(ISP) triblock terpolymers with cylindrical structures. When average composition of a blend is a little off from symmetry, i.e., composition ratio of three components are 0.24/0.59/0.17 for I/S/P, the system show unusual cylindrical array, where gray P domain has 5 black I domain neighbors, however it has found this structure is a periodic one with hexagonal symmetry. The other system is star-shaped terpolymers from the same polymer species, that is polyisoprene(I), polystyrene(S) and poly(2-vinylpyridine)(P). It was clarified that if composition ratio is in the vicinity of 1/1/1 for I/S/P, terpolymers tend to exhibit cylindrical structures whose cross sections possess the feature of regular two-dimensional tilings, that is, Archimedean tilings. However, when the ratio is varied to some extent, the structure formed deviates from regular tiling, and finally the sample, I1S2.7P2.5, was confirmed to show quasicrystalline tiling with dodecagonal symmetry as also verified by X-ray diffraction experiments.[1]

[1] *K. Hayashida, T. Dotera, A. Takano, Y. Matsushita Phys. Rev. Lett. 2007, 98, 195502*

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