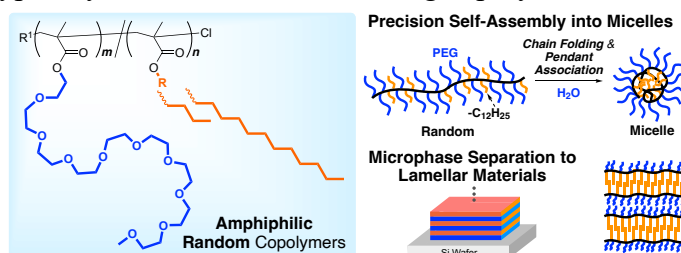


Precise yet Dynamic Self-Assembly of Amphiphilic Polymers into Nanostructured Soft Matter

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Precise yet dynamic self-assembly of amphiphilic polymers is important in creating nanostructured soft matter that is responsive to temperature, pH, salts in water or humidity in outer environments. Recently, we have developed self-assembly systems of amphiphilic random or alternating copolymers comprising hydrophilic poly(ethylene glycol) (PEG) and cationic groups and hydrophobic alkyl groups (Figure 1). Typically, the random or alternating copolymers induce chain-folding via the association of the hydrophobic groups in water to form small micelles (~10 nm).^{1,2} Random copolymers carrying PEG and octadecyl groups form sub-10 nm lamellar structures via the crystallization of the octadecyl groups.³



In this paper, we report the recent advances of amphiphilic polymer self-assemblies: (1) design of amphiphilic random or alternating copolymer micelles in water;^{1,2} (2) reversible control of co-self-assembly or self-sorting of binary amphiphilic copolymers into fused or discrete micelles in water (Figure 2a);⁴ and (3) water-assisted microphase separation and morphology control by water absorption. For example, cationic alternating copolymers bearing imidazolium chloride and hydrophobic groups induce microphase separation via water-vapor annealing (Figure 2b).⁵ The copolymers efficiently absorbed water into the cationic segments from the outer environments, depending on the relative humidity. The absorbed water modulates the weight fraction of hydrophilic/hydrophobic units in the samples. Thus, the morphologies and domain spacing of the nanostructures are controlled by not only the side chains but also the amount of absorbed water.

Figure 1: Self-assembly of amphiphilic random copolymers bearing PEG and alkyl groups into micelles in water and lamellar bulk or film materials.

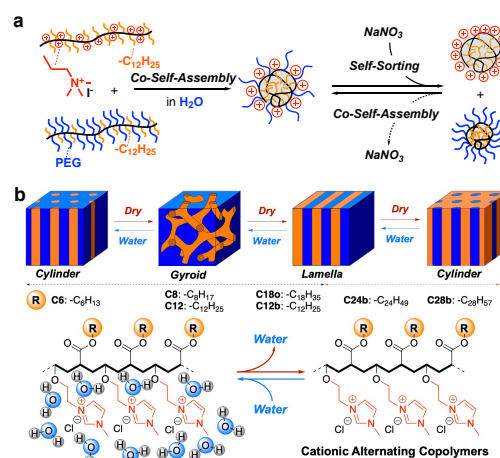


Figure 2: (a) Co-self-assembly and self-sorting of a cationic copolymer and a PEG copolymer in water. (b) Morphology control of cationic alternating copolymers via water absorption.

The self-assembly of the cationic copolymers afforded universal access to various morphologies including lamella, gyroid, and cylinder, in addition to the precise control of the domain spacing.

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