 USES Conf. Proc. 01 (2014); doi: 10.15445/01022014.14

Polymerisation-induced Self-assembly

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Abstract

Polymers are long-chain molecules that typically do not mix with other types of polymers. Thus, for example, if a water-insoluble polymer is grown from a water-soluble polymer in aqueous solution (see Figure 1), this leads to in situ self-assembly to produce a remarkable range of spherical, worm-like or vesicular (i.e. hollow) diblock copolymer nanoparticles (see Figure 2), with the final copolymer morphology depending on the precise reaction conditions. This so-called 'polymerisation-induced self-assembly' (PISA) approach is reproducible, efficient and generic – it works equally well in polar solvents (e.g. water or ethanol) or non-polar solvents (e.g. *n*-alkanes).[1-10] PISA provides a highly versatile and scalable platform technology for the production of a wide range of nanoparticles with many potential applications, including viscosity modifiers/thickeners, engine oil lubricants, anti-reflective coatings, thermo-responsive hydrogels for the long-term storage of stem cells and next-generation contact lenses. We are currently working with various industrial sponsors to explore these possibilities.

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Keywords Polymers; Polymerisation; Nanoparticles; Self-assembly; Water

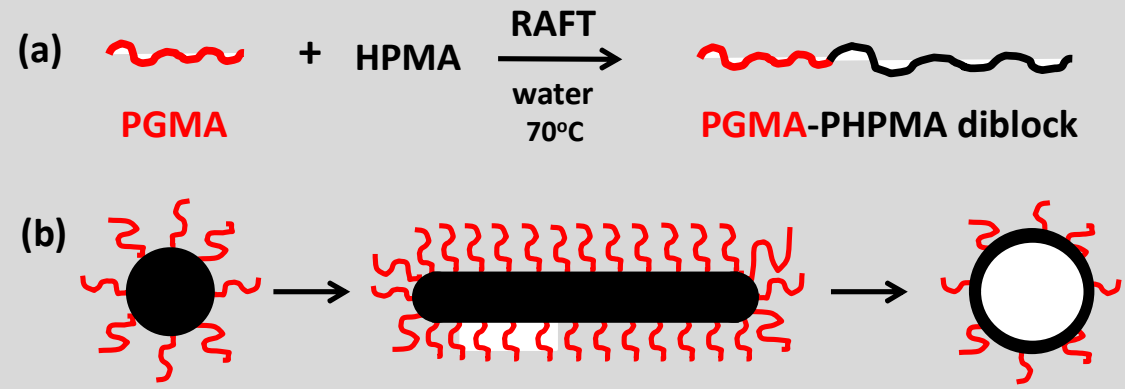

Figure 1. *(a) Polymerisation of a water-miscible monomer (HPMA) from one end of a water-soluble polymer (PGMA) to form a PGMA-PHPMA diblock copolymer in water; (b) the hydrophobic nature of the PHPMA block drives in situ self-assembly to form either spheres, worms or vesicles.*

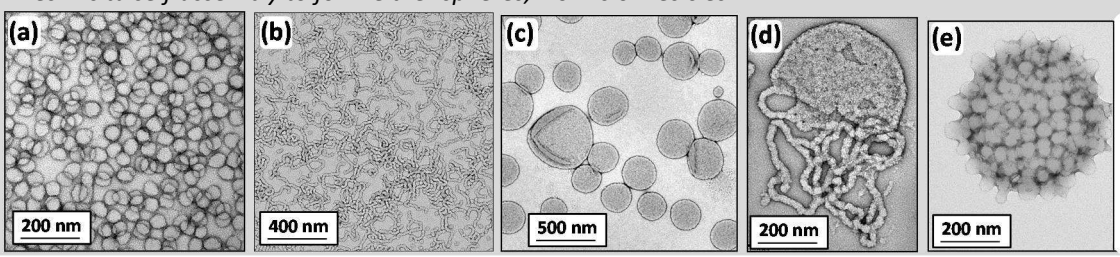

Figure 2. *Representative transmission electron micrographs of (a) spheres, (b) worms, (c) vesicles, (d) jellyfish and (e) framboidal vesicles prepared by RAFT aqueous dispersion polymerisation of 2-hydroxypropyl methacrylate (HPMA) from one end of a water-soluble polymer (PGMA) at 70^{o}C.*