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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

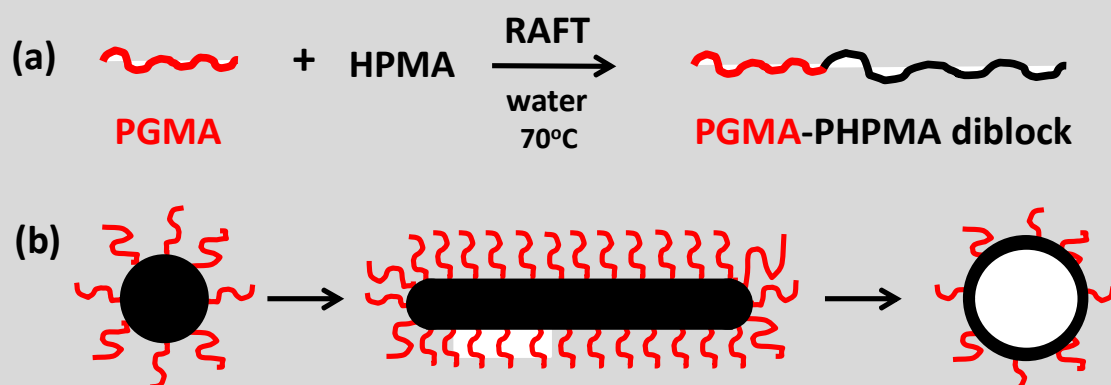


Figure 1. (a) Polymerisation of a water-miscible monomer (HPMA) from one end of a water-soluble polymer (PGMA) to form a PGMA-PHPMA diblock copolymer in water; (b) the hydrophobic nature of the PHPMA block drives in situ self-assembly to form either spheres, worms or vesicles.

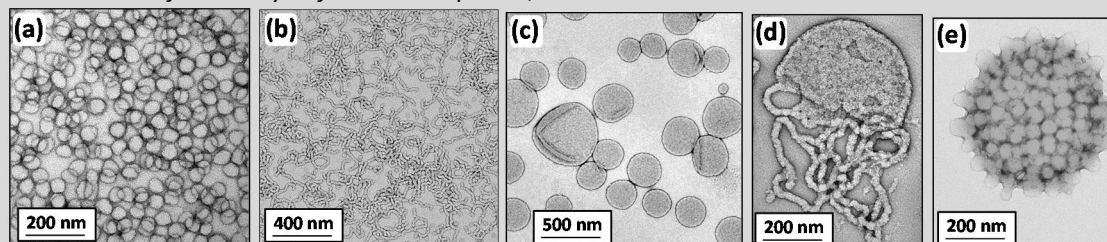


Figure 2. Representative transmission electron micrographs of (a) spheres, (b) worms, (c) vesicles, (d) jellyfish and (e) framboidal vesicles prepared by RAFT aqueous dispersion polymerisation of 2-hydroxypropyl methacrylate (HPMA) from one end of a water-soluble polymer (PGMA) at 70°C.