Materials Science and Engineering Department

Winter Seminar Series

Polymerisation-Induced Self-Assembly (PISA): A Platform Technology for Bespoke Polymer Colloids

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Polymerization-induced self-assembly (PISA) is a powerful and versatile technique for the rational synthesis of concentrated dispersions of block copolymer nano-objects of controllable size, shape and surface chemistry. In essence, an insoluble block is grown from one end of a soluble block in a suitable solvent. Once the former block reaches a certain critical degree of polymerisation, micellar nucleation occurs and the latter block then acts as a steric stabiliser. Unreacted monomer diffuses into the copolymer cores, which leads to a relatively high local concentration and hence a significant rate acceleration. The final copolymer morphology is typically spheres, worms or vesicles, although other morphologies can also be accessed. The design rules for PISA are generic: it may be conducted in water, polar solvents or non-polar solvents using reversible addition-fragmentation chain transfer (RAFT) polymerisation.

Over the past decade, PISA has become a useful platform technology for the rational design of bespoke polymer colloids. For example, such block copolymer nano-objects can be used as model Pickering emulsifiers for the preparation of (nano)emulsions, as dispersants for either organic agrochemical actives or inorganic pigments, as superflocculants for μm-sized particles, as next-generation lubricants for ultralow viscosity automotive engine oils, as highly biocompatible worm gels for cell biology studies or for the design of uniquely thermoresponsive amphiphilic diblock copolymers that can form spheres, worms or vesicles in aqueous solution simply by adjusting the temperature from 5 oC to 50 oC. Some of these examples will be discussed in this lecture.

Prof. Armes studied for his BSc (1983) and PhD (1987) at the University of Bristol. He then worked as a postdoctoral fellow at Los Alamos National Laboratory in New Mexico for two years before taking up a lectureship at the University of Sussex. He was promoted to Professor in 2000 and moved to the University of Sheffield in 2004. His research interests are focused on polymer colloids and he has published 680 peer-reviewed papers (H-index = 118). His research has been recognised by the award of six RSC medals and he was elected as a Fellow of the Royal Society in 2014.

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