Weekly Seminar by Professor Karen J Edler
Department of Chemistry, University of Bath, UK

From Micelles to Materials
Tuesday, 3rd July at the Department of Molecular Sciences, Macquarie University

Abstract

We study self-assembled amphiphiles used to template nanostructures in other materials and attempt to understand hierarchical structure formation as these nanostructured particles themselves form microparticles or films. The interaction between silica oligomers and cationic micelles under alkaline conditions is the initiating step in the original micelle templated silica synthesis, but this interaction has been difficult to study due to the wide range of different size scales involved. To obtain some insights into the initial silica-micelles interactions we have used $^{29}$Si NMR, and wide angle neutron scattering with empirical potential structural refinement (EPSR) modelling to attempt to better understand the interactions between silica oligomers, water and surfactant molecules. At larger length scales we use grazing incidence X-ray small angle scattering (GISAXS) provide details on the processes of mesophase construction in films, and have combined the novel Spin Echo Modulated small angle neutron scattering (SEMSANS) technique with standard SANS to simultaneously measure micron scale particle growth and mesostructure formation in reacting silica solutions – answering the question of which comes first: macrostructure or mesoscopic ordering? Finally, I will mention some of our currently developing work on templated materials formed in non-aqueous solvents.

Biography

Karen J Edler is Professor of Soft Matter in the Department of Chemistry, University of Bath, studying nanoscale structure formation in self assembling systems, characterised principally using scattering techniques. She did a BSc/LLB at the University of Sydney, then graduated with a PhD in Physical Chemistry from the Australian National University in 1998, studying micelle templated silica with Prof John White. She then did postdocs at Cornell University (1997-1999), NY and jointly at the Universities of Bristol and Bath (1999-2000), UK. She was appointed as a Royal Society Dorothy Hodgkin Research Fellow in 2000, in the Chemistry Department at Bath, where she has remained. She is now Head of Group for Physical Chemistry and held a Visiting Professorship in the Physical Chemistry Division, Lund University, Sweden (2012-17) and, now in the School of Chemistry, University of Sydney (2018).

Her research focuses on self-assembly of functional hierarchically-structured materials. Understanding interactions between surfaces, nanoparticles, micelles and polymers is central to control over structure and thus function. Time-resolved grazing incidence diffraction, X-ray & neutron reflectivity or small & wide-angle scattering are used to study interactions & structure, and a range of complementary techniques (TEM, SEM, NMR, DLS, surface tension, conductivity, XRD, SESANS, gas adsorption) are applied to determine formation mechanisms & structures across many length scales. Extensive collaborations with other groups in industry & academia apply novel materials synthesised in her group to applications from drug delivery to membrane protein structural studies to solar cells, nanomaterial catalysts and “green” formulations for personal care.

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