Nanostructured Materials from Natural / Synthetic Polymer Conjugates

Sébastien Perrier
Key Centre for Polymers & Colloids
School of Chemistry, The University of Sydney
NSW 2006
T +61 2 9351 3366; F +61 2 9351 3329; E sebastien.perrier@sydney.edu.au
W http://www.kcpc.usyd.edu.au

Chemists are remarkably proficient at directing the synthesis of small molecules, but fine-tuning the structures of large molecules, such as those found in polymers, is far more taxing. Despite many years of research, the field of macromolecular engineering i.e. the preparation of large molecules with strict control over their size and chemical groups has many mountainous challenges yet to overcome. Nature provides endless examples of precisely engineered macromolecules; proteins, for instance, which contain amino-acid side-chains that are accurately positioned, often in a way that determines the proteins' roles. Synthetic chemists have tried to recreate nature's exceptional control over macromolecules, and in so doing they have designed new materials with precisely defined structures, for use in applications ranging from materials to medicine.

The lecture will describe the use of modern polymerization techniques to mediate the synthesis of polymeric architectures with excellent control over their topology and functionality. These synthetic macromolecules are then exploited to directly form functional materials, or associated to biopolymers such as peptides and cellulose to form natural / synthetic polymer conjugates. The exploitation of these well-defined macromolecules for the design of functional nanostructured materials via molecular self-assembly and self-organization will be discussed, with examples of applications in the material and biomedical fields.

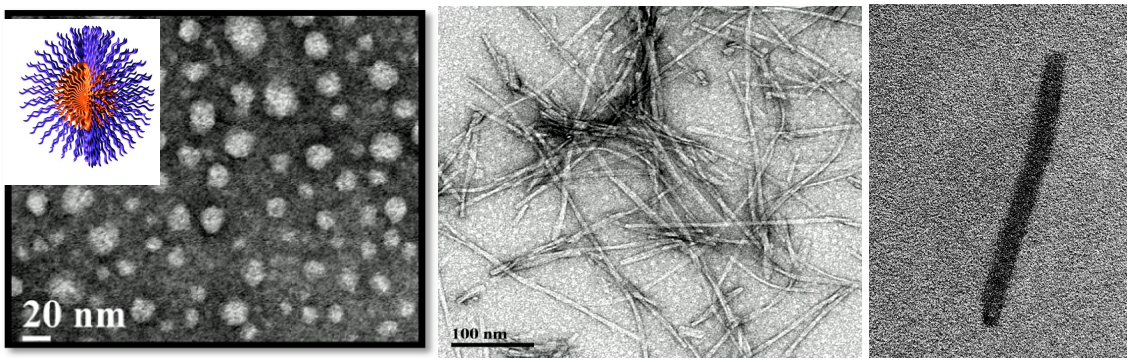

Figure 1. *Examples of soft nanoparticle, nanorods and nanotubes obtained fromt the self assembly of peptide-polymer conjugates.*

Selected Recent Publications

1/ Konkolewicz, D.; Poon, C. K.; Gray-Weale, A.; Perrier, S. Hyperbranched Alternating Block Copolymers using Thiol-Yne Chemistry: Materials with Tuneable Properties, *Chem. Commun.*, **2010**, DOI:10.1039/C0CC02429E; 2/ Kakwere, H.; K.Y. Chun, C.; Jolliffe. K.A.; Payne, R.J., Perrier, S. Polymer-peptide chimeras for the multivalent display of immunogenic peptides. *Chem. Commun.*, **2010**, 46, 2188-2190; 3/ Semsarilar, M.; Ladmiral, V.; Perrier, S. Highly branched and hyperbranched glycopolymers via reversible addition fragmentation chain transfer polymerization and click chemistry. *Macromolecules*, 2010, 43 (3), 1438–1443; 4/ Sriprom, W.; Neto, C.; Perrier, S. Rapid photochromic nanopatterns from block copolymers. *Soft Matter*, **2010**, 6, 909-914; 5/ Chapman, R.; Jolliffe, K.A; Perrier, S. Synthesis of self assembling cyclic peptide-polymer conjugates using click chemistry, *Aust. J. Chem.,* **2010**, 63, 1169-1172; 6/ Konkolewicz, D.; Gray-Weale, A.; Perrier, S. Hyperbranched polymers by thiol-yne chemistry, from small molecules to functional polymers*. J. Am. Chem. Soc.*, **2009**, 131 (50), 18075-18077; 7/ Kakwere, H.; Perrier, S., Orthogonal "relay" reactions to design functional soft nanoparticles. *J. Am. Chem. Soc.* **2009**, 131(5), 1889-1895; 8/ Suchao-in, N.; Chirachanchai, S.; Perrier, S. Control of block copolymer morphology: an example of selective morphology induced by self- assembly formation condition. *J. Polym. Sci., Part A: Polym. Chem.*, **2009**, 47 (24), 6783-6788; 9/ Ladmiral, V.; Legge, T. M.; Zhao, Y. L.; Perrier, S., "Click" chemistry and radical polymerization: Potential loss of orthogonality. *Macromolecules* **2008**, 41, (18), 6728-6732.

A/Professor Sébastien Perrier graduated from the Ecole National Supèrieure de Chimie de Montpellier, France, in 1998. He undertook his PhD at the University of Warwick, England, in polymer chemistry and spent one year as a postdoctoral fellow at the Centre for Advances Macromolecular Design (University of New South Wales), Australia. In 2002, he was appointed as lecturer at the University of Leeds, and was promoted senior lecturer in 2005. In October 2007, he moved to the University of Sydney, and was appointed as director of the Key Centre for Polymers & Colloids. A/Prof Perrier leads a team of 10-15 researchers working at the interface of organic chemistry, polymer synthesis, and material science. He has published over 70 peer reviewed research papers and book chapters and over 50 conference papers/abstracts. He is a member of the editorial boards of *Soft Matter*, *Macromolecules*, *European Polymer Journal* and *Polymer Chemistry*. Awards include an ARC international fellowship (2002) and the Macro Group UK Young Researcher Award (2006), the Young Tall Poppy Science Award (2009), the Rennie Memorial Medal (2009) and the David Sangster Polymer Science and Technology Award (2009). His research interests lie at the interface of polymer synthesis, materials / soft matter science and biology.