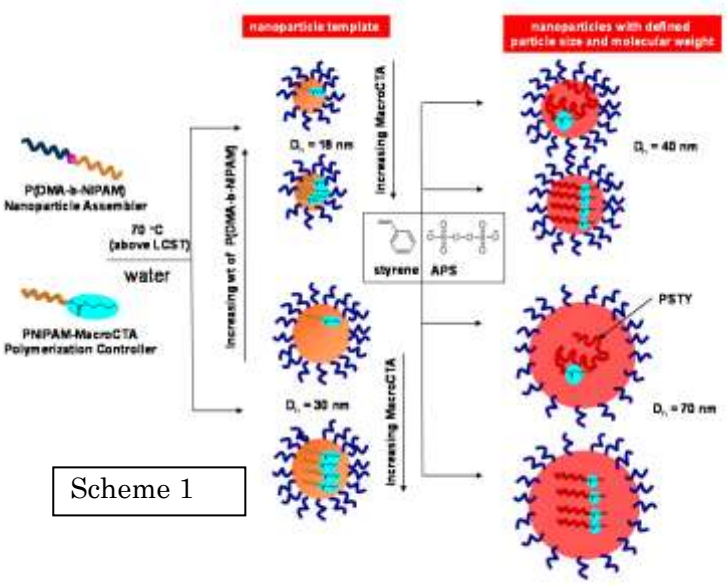
MONODISPERSE POLYMER NANOPARTICLES: INDEPENDENT CONTROL OF PARTICLE SIZE AND MOLECULAR WEIGHT

Michael J. Monteiro[1]

[1] Australian Institute for Bioengineering and Nanotechnology, The University of Queensland, Australia

ABSTRACT

The discovery of living polymers by Szwarc over 50 years ago started the field of synthesizing well-defined polymers with desired chain lengths through anionic polymerization. The field has significantly grown to include cationic, metathesis and 'living' radical polymerization. 'Living' radical polymerization (LRP), one of the most versatile of the techniques, allows one to make well-defined polymer chains and architectures from a wide range of chemical compositions and under diverse experimental conditions. Considerable attention has been directed towards the synthesis of polymer nanoparticles via LRP in an aqueous dispersed medium (i.e. emulsion). This is the ideal low cost effective way to commercialize the technology with applications ranging from high strength coatings, biomedicine, colloidal crystals for diagnostic kits, to nanoreactors for environmentally friendly organic reactions. It has taken over 10 years for LRP to successfully be used to produce well-defined polymer chains in an emulsion process with desired molecular weight and usually with broad particle size distributions. The reasons for the difficulty of translating LRP from bulk or solution to an aqueous dispersion stems from the complex kinetic and thermodynamic factors that determine the efficiency of the 'living' agent (or 'polymerization controller') inside the nanoreactors (usually consisting of surfactant-based micelles). However, in order to realize the wide range of commercial applications, polymer nanoparticles should be prepared with independent and precise control over both molecular weight and particle size. To date obtaining this level of control has been elusive. We report, using a specially designed nanoreactor or nanoparticle template, the synthesis of polymer nanoparticles with well-defined and desired particle sizes (on the nanoscale) and polymer molecular weights (Scheme 1). More importantly, the particle size and molecular weight distributions were narrow determined from the low polydispersity indexes (PDIs) obtained.



Scheme 1

References:

1. K. O. Sebakhy, S. Kessel, and M. J. Monteiro *Macromolecules*, Articles ASAP
2. Carl N. Urbani and Michael J. Monteiro *Macromolecules*, **2009**, *42* (12), pp 3884–3886

Prof. Michael J. Monteiro PhD (ARC Future Fellow)

Australian Institute for Bioengineering and Nanotechnology, University of Queensland, Australia, Tel: +61 7 3346 4163, E-mail: m.monteiro@uq.edu.au