Title: Preparation of High Solids-Content Nanosize Polymer Latexes by Monomer-Starved Emulsion Polymerisation Reactions

Shahriar Sajjadi
Division of Engineering
King's College London
Strand, WC2R 2 LS

Nanosize polymer latexes are being developed and commercialised for their superior role as drug delivery carriers, impact modifiers for plastics, ultra-thin coatings and so on. Microemulsion polymerisation is widely used for preparation of such nano-latexes. However, microemulsion polymerisations have a few important drawbacks; they usually require a co-surfactant, use a high ratio of surfactant/monomer, and can only produce low-solids content polymer latexes. Alternatively, monomer-starved semibatch emulsion polymerisation reactions can produce nano-particles within the same size range as that obtainable from microemulsion polymerisation (20-50 nm), but with a much lower amount of surfactant used and with a higher solids content. The presentation reviews procedures by which nano-latexes can be produced. In a semibatch emulsion polymerisation, for example, the monomer distribution ratio between the reactor charge and the feed is the key factor in determining the size of particles. The smallest particles are usually produced if a monomer is added at a very low rate to an aqueous solution of micelles and an initiator. Under monomer-starved condition the rate of particle growth is depressed. This allows the emulsifier micelles to be depleted at a slower rate and thus enhances particle nucleation. By controlling the rate of growth of particles at a very low level, it is possible to produce particles as small as 15-20 nm. Research shows that diffusion-controlled polymerisation, caused by poor mixing, can also enhance particle formation. In extreme cases, particles with core-shell morphologies are produced. Models, together with a comparison with experimental data, will be presented. The models can explicitly explain why monomer-starved nucleation will lead to the formation of a large number of nano-particles. The evolution of particle size distributions, and their characteristic features, will be discussed.