

VISCOSITY AND MIXING STUDIES OF CORE-SHELL POLYMERS USING TIME DELAY FLUORESCENCE SPECTROSCOPY

M. Hodgson and Prof R.D. Sanderson

Institute for Polymer Science, University of Stellenbosch

ABSTRACT

The synthesis of core-shell polymers by means of an emulsion process where polymerization conditions are controlled has gained importance in the coatings industry as they strive to synthesize superior paints.

Ideal core-shell structure

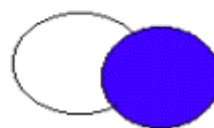
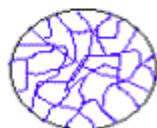
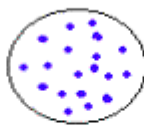
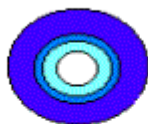
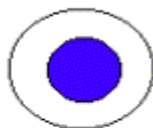


Second stage polymer



First stage polymer

Deviations from the ideal core-shell structure



As the morphology of the latex particles and the interface between two components can sensitively change the macroscopic properties of materials over a wide range, it is important to fully investigate the particle morphology. Many deviations from the idealistic core-shell structure are possible:

Fluorescence techniques are in widespread use as a means of characterizing polymer systems and fluorescence quenching techniques have been used in the study of emulsion polymerization and latex characterization.¹

9-vinyl anthracene (energy acceptor) and 2-vinyl naphthalene (energy donor) were incorporated into the core and the shell respectively by means of co-polymerization, as a means of fluorescence labeling. Polymerization conditions that were varied included temperature, emulsifier concentration, degree of crosslinking, reaction time, monomer type and mode of addition.

Fluorescence non-radiative energy transfer is a distance dependant interaction between the electronic excited states of two dye molecules. By the energy transfer that is observed and by the use of different models pertaining to concentration profile, deductions can be made concerning the morphological structure of the particle.

Good incorporation of the fluorescence monomers into the latex particles was achieved but the goal of full incorporation is yet to be achieved due to the difficulties associated with the transfer of exotic molecules through the water phase in emulsion polymerization which compounds the difficulty of reactivity ratios. Partial incorporation will lead to non-radiative energy transfer occurring at sites other than the core-shell interface. Self-synthesis or a change in polymerization medium is necessary for the above problem to be overcome.

Time resolved anisotropy measurements can be used on the synthesized particles to selectively excite chromophoric groups in a plane and by monitoring their reorientation deductions can be made about the local viscosity (reorientation of the chromophore is linked to the movement of the polymer chain or segments²).

References:

1. M.A. Winnik, Huilin Xu and R. Satguru; Makromol. Chem, Macromol. Symp **70/71**, 107-117 (1993)
2. I. Soutar, C. Jones, D.M. Lucas and L. Swanson; Jnl of Photochemistry and Photobiology A:Chemistry **102**, 87-92 (1996)