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THE MORPHOLOGY OF EMULSION POLYMERIZED LATEX PARTICLES*

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ABSTRACT

Under monomer starved feed conditions, emulsion polymerization of perdeuterated methyl methacrylate and styrene in the presence of preformed polymethylmethacrylate latexes resulted in particles with a core-shell morphology, as determined by small-angle neutron scattering (SANS) analysis for a hollow sphere. The locus of polymerization of the added deuterated monomer is therefore at the particle surface. In similar measurements a statistical copolymer of styrene and methyl methacrylate was used as seed particles for further polymerization of trideuteromethyl methacrylate. The resulting polymer latex was again shown to have a core-shell morphological structure as determined by SANS. In both studies the overall size of the particle was in excellent agreement with the values obtained by other techniques (light-scattering, transmission electron microscopy, etc.). SANS experiments were also undertaken on polystyrene latexes polymerized by equilibrium swelling methods, with deuterated polymer forming the first or second step. The experiments covered a molecular weight range $6 \times 10^4 < M < 6 \times 10^6$ g/mol. For $M > 10^6$ the molecular weights determined via SANS and also by gel permation chromatography (GPC) are consistent with the experimental errors, indicating that the deuterium labeled molecules are randomly distributed in the latex. These results led to the finding that the polymer chains were constrained in the latex particles by factors of 2-4 from the relaxed coil dimensions. For $M < 10^6$ g/mol SANS gave zero angle scattering intensities much higher than expected on the basis of a random distribution of labeled molecules. Several models were examined, including the possible development of core-shell structures at lower molecular weights.

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