Silica-stabilized, Micrometer-sized Polystyrene Latex Particles Prepared via Alcoholic Dispersion Polymerisation

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Micrometer-sized polystyrene latex particles were obtained by the dispersion polymerisation of styrene in either methanol or 2-propanol in the presence of a commercial 13 nm alcoholic silica sol using AIBN initiator at 60 °C. Thermogravimetric analysis confirmed that the silica content was less than 1 % by mass. However, styrene polymerisations conducted under the same conditions in the absence of the silica sol always led to macroscopic precipitation, with no evidence for particle formation. Thus the presence of the silica sol is essential for the production of colloidally stable latex particles. Close inspection by transmission electron microscopy confirms the silica sol is located at the latex surface and the sol distribution appears to be patchy (i.e. submonolayer coverage), rather than a continuous shell. This is consistent with the low silica content of these particles. Aqueous electrophoresis studies indicated isoelectric points of around pH 6-7.5 for the silica-stabilised latexes, whereas the original silica sol remained anionic over the whole pH range studied. Increasing the silica sol concentration in the formulation from 2 to 8 w/v % leads to a systematic reduction in the latex size distribution, as judged by disc centrifuge photosedimentometry. Scanning electron microscopy studies confirm that the latex particles have spherical morphologies and are relatively monodisperse. These particles have densities similar to that of polystyrene but have some of the surface properties of silica. Since the syntheses are completely surfactant-free, these new hybrid particles may offer some advantages in immunodiagnostic assays. Replacing AIBN with a cationic azo initiator leads to ill-defined non-spherical polystyrene-silica particles with a mean particle diameter of 420 nm. In this case thermogravimetric analyses indicate a silica content of 22 % by mass, which suggests that the electrostatic interaction between the cationic initiator and the anionic silica sol promotes the formation of nanocomposite particles, rather than silica-stabilised latexes.