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SYNTHESIS OF MULTICOMPARTMENT NANOPARTICLES

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Core-shell latex particles are applied for many decades. Encapsulation if all kind of materials like pigment particles, filler particles and magnetic particles is known for many years. Even in the field of incorporating nanotubes in matrix material the encapsulation of these nanotubes with latex particles facilitates dispersion tremendously.

In the field of encapsulation of many types of particles like pigments, fillers and clay particles [1,2] tremendous progress has been made and applications of encapsulated inorganic particles are known, for example in car coatings. A new challenge is in the encapsulation if clay platelets striving towards a high aspect ratio of the resulting nanostructured particles. One is struggling with surface tensions there and the thermodynamic driving force to small surface area. In the field of vesicle polymerization [3], after careful studies it turned out to be very difficult to produce a thin wall of polymer inside the hydrophobic domain of the vesicle double. The most common structure produced is that of the parachute, a latex particle connected to the vesicle structure. Apparently only with strong covalent bonds between the surfactant and the polymer one is able to produce hollow particles through vesicle polymerization. The field of vesicle polymerization opens many possibilities to produce many different and interesting new nanostructured particles. The control of molecular microstructure and morphology through on-line techniques like Raman spectroscopy [4] gives additional options for nanostructuring. The phenomenon of phase separation in latex particles not only is controlled by thermodynamic factors (mainly interfacial tensions) but only by kinetic factors (rates of diffusion linked to the local viscosities). With on-line techniques it is possible to control the formation of particular chemical composition distributions, which might or might not thermodynamically lead to phase separation. It is shown that running the reaction at a high internal viscosity (high conversion in a semi-continuous operation) phase separation can be prevented. So in this way both molecular microstructure and morphology of the latex particles can be controlled with on-line techniques like Raman spectroscopy.

Specialty applications like intraocular eye lenses bases on transparent latices are showing the enormous potential of nanocomposites in the area of specialties [5].

So the field of emulsion polymerization is maturing to a science where control on a nanolevel becomes common practice and moreover the synthesis and application of these nanostructured particles can be on bulk scale (in contrast to the single molecule manipulation nanotechnology).

Added to this is the introduction of controlled radical polymerization techniques as an additional means to control molecular microstructure and morphology in latex systems.

The fact that it is common practice to produce many tons of nanostructured polymeric materials with emulsion polymerization does not mean that this area should be excluded from the field of nanotechnology (which is often done).

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