Spreading of nanofluids on solids

D. T. Wasan and A. D. Nikolov
Nature, 2003, **423**, 156–159

Desirable mechanical and optical properties can be obtained from suspensions of nano-sized particles, that are important for lubrication and enhanced oil recovery. The authors have prepared a sample of nanofluid in a suspension of monodisperse charged 1 μm latex spheres in deionized surfactant-free water that forms a wedge film after blowing a small air bubble (diameter 200 μm) against an optically smooth glass plate. The pressure profile on the wedge wall shows that the film disjoining pressure versus film thickness goes through an oscillatory decay. The video microscopy describes the spreading dynamics at the three-phase contact region.

Synthesis and shape modification of organo-functionalized silica nanoparticles with ordered meso-structured interiors

S. Sadasivam, D. Khushalani and S. Mann
J. Mater. Chem., 2003, **13**, 1023–1029

Nanoparticles have been prepared by co-condensation of derivatives of silanes under alkaline conditions and the synthesis is confirmed by solid state ^{13}C and ^{29}Si MAS NMR spectroscopy. The TEM studies show oblate ellipsoidal crystals with cylindrical micelles. Thiol-functionalized particles generate elongated nanofilaments with hexagonal mesostructures. It suggests the surface charge as the primary determinant of nanoparticle morphology. The method may find use in synthesis of new catalytic material.

Magnetic fluid-based separator: Design and development

K. Parekh
Indian J. Pure Appl. Phys., 2003, **41**, 319–322

A magneto-hydrodynamic separator works on the principle of magnetic separation due to a levitation force exerted on an immersed, non-magnetic material in a magnetic fluid when subjected to a gradient magnetic field. The apparent density of magnetic fluid can be varied by changing the magnetic field gradient or by changing the magnetization. By using a magnetic fluid and by controlling its apparent density, materials having different densities can be separated and recovered from the waste material. The model described can separate over a density range of 2–8 g/cc, and diameter up to 1 mm. A prototype model is fabricated in the laboratory, using permanent ferrite magnets.

Exact replication of biological structures by chemical vapour deposition of silica

G. Cook, P. L. Timms and C. Goltner-Spickermann
Angew. Chem. Int. Ed., 2003, **42**, 557–559

Exact replicas of biological structures are reproduced by a chemical vapour deposition method making clusters of silica from silane. The biological material serves as a template and can be removed through calcination at 500°C in air. The coated material and the final calcined inorganic silica can be handled with tweezers easily. The typical thickness of the silica layer ranges between 100 nm and 2 μm. This method is suitable for conservation of delicate biological specimens.

The 'Indian wire trick' via parametric excitation: A comparison between theory and experiment

T. Mullin *et al.*
Proc. R. Soc. London, 2003, **A459**, 539–546

The authors describe a paradoxical gravity-defying experiment where a length of wire is stabilized by vertical periodic oscillation of its support with an upper and a lower bound on the excitation frequency, a phenomenon that relies on the so-called resonance–tongue interaction.

Similarities between communication dynamics in the Internet and the autonomic nervous system

K. Fukuda *et al.*
Europhys. Lett., 2003, **62**, 189–195

The authors discover a surprising analogy between the communication dynamics in the Internet and the autonomous nervous system (ANS) that controls involuntary motor actions. The time interval between successive heartbeats provides a probe of the communication dynamics for the ANS. Statistical properties of healthy heart rate variability and non-congested Internet traffic, and diseased heart rate variability and congested Internet traffic are reported.

Rational design of a calcium-binding protein

W. Yang *et al.*
J. Am. Chem. Soc., 2003, **125**, 6165–6171

A *de novo* calcium-binding site is designed into the framework of a non-calcium binding protein. The resulting hybrid preferentially binds Ca^{2+} in competition with Mg^{2+} with an affinity comparable to that of a cognate natural system. The new site is engineered on the basis of a survey of natural calcium-binding proteins and chelators. This report claims the first successful metalloprotein design that has a high co-ordination metal-binding number reconstructed into a host protein.

Identifying kinetic barriers to mechanical unfolding of the *T. thermophila* ribozyme

B. Onoa *et al.*
Science, 2003, **299**, 1892–1895

Mechanical unfolding of the higher order structures of RNA found in *Tetrahymena* ribozyme proceeds via eight intermediates, with lifetimes of seconds, and rupture forces of 10–30 pN. The experimental investigation of single molecule dynamics reveals that the unfolding process is Mg^{2+}-dependent, and though reversible, is hysteretic, and contrasts with thermal melting in the sense that secondary structures and tertiary contacts are retained.

Electrostatic self-assembly of macroscopic crystals using contact electrification

B. A. Grzybowski *et al.*
Nature Mater., 2003, **2**, 241–245

The authors report use of contact electrification electrostatic self-assembly of two types of macroscopic components. Two kinds of objects, usually spherical, made of different polymeric materials that change with opposite electrical polarities when agitated on flat, metallic surfaces are used. The electrostatic interaction among the charged pair particles is the basis of self-assembly into an ordered array. The stability of these structures is explained by the induced electric dipoles in the particulate aggregate.