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Nanomaterials

The International Year of Chemistry 2011 was celebrated with great enthusiasm all over the world. A special section on 'Chemistry – Structure, Synthesis and Dynamics' was brought out by this journal in the 10 October 2011 issue. As part of the ongoing effort to celebrate chemistry, this issue has a special section on nanomaterials which includes four articles and a conversation with a nanotechnologist at IIT-Kanpur, Ashutosh Sharma (**page 19**).

Surfaces of metal single crystals, particularly the low index planes, have been extensively used during the past few decades as substrates to study molecular adsorption, reactivity in a catalytic reaction, dynamics of molecules in self-assembled monolayers, etc. In such studies, Au(111) surface has received unprecedented attention owing to its inertness and relative ease of fabrication. While conventional physical methods for growing single crystals such as Bridgman, Czochralski and zone melting, are effective but cost-prohibitive, the bottom-up chemical approaches prove to be inexpensive. The latter, however, produce single crystals only in the form of nanoparticulates. Realizing that the substrate should at least extend to millimetre scale for meaningful usage, there have been many efforts in the literature to push the limit upward achievable by the chemical methods; however such efforts have been futile, often giving rise to a mix of various anisotropic structures from which separating desired specimens is like removing a needle from haystack! Kulkarni *et al.* (**page 70**) report a method of synthesis of giant Au(111) single crystalline microplates involving simple air thermolysis of a single source chemical precursor. They demonstrate the utility of the obtained microplates as substrates in scanning tunnelling microscopy, fluorescence and Raman signal enhancement.

Jagirdar *et al.* (**page 78**) have developed a new solid state synthetic route for silica and alumina supported Pt and Pd nanoparticles. The methodology involves grafting of metal ions on the support materials followed by their solid state reduction. Ammonia borane ($NH_3{\cdot}BH_3$, AB) reduces the metal ions in the solid state and simultaneously generates a BNH_x polymer which essentially halts the growth of metal nanoparticles formed. As a result, metal nanoparticles encapsulated by the BNH_x polymer and dispersed on the alumina or silica surface were obtained. The capping agent, BNH_x polymer was removed by washing the powders with methanol. The particle size as well as the size distribution could be controlled because of the presence of the stabilizing agent; the stabilizing agent also prevents any sintering of particles. The synthetic protocol developed here overcomes some of the key problems and hence likely to be sustainable for a variety of systems.

Recent developments in the design of plasmonic nanostructures and their assembly have opened up newer possibilities in surface enhanced spectroscopy. Detailed analysis of the near-field and the far-field properties of the metal nanostructures can provide valuable information on the design of plasmonic nanostructures which can enhance the spectroscopic signals from various analyte molecules of significance in health, environment and safety. Localized surface plasmon resonances in metal nanostructures depend on the size and the shape of the materials. The near-field and the far-field optical properties of spherical gold nanoparticles and gold nanorods were studied, using Finite Difference Time Domain studies by Swathi *et al.* (**page 85**). The amplitudes of the electric fields on the surface of Au nanorods were found to be ~2–3 orders of magnitude higher when compared to those around spherical Au nanoparticles. The junctions between the nanorods are locations of enhanced fields (hotspots) due to the occurrence of coupled plasmons. Numerical results thus obtained are compared with the published experimental data from the same group. These results can provide valuable insights into the rational design of suitable geometries to be explored in experiments.

Madras *et al.* (**page 97**) have developed a new family of castor oil-based biodegradable polyesters. These polyesters were synthesized by a simple process that does not use any catalysts and is based on monomers that can be metabolized *in vivo* such as castor oil, mannitol and citric sebacate. The polymers were characterized to determine the tensile, hydration and degradation properties. The mechanical properties indicate that the polymer has characteristics of a soft material and the hydration tests indicate that the surface of the polymer is hydrophilic. The *in vitro* degradation studies show that the time for complete degradation of the polymer was around 21 days but can be tuned by varying the curing conditions. These polymers were also shown to be biocompatible to human fibroblast cells. The potential of this polymer as a drug carrier was studied using two drugs, 5-fluorouracil and isoniazid. The release rate was studied by varying the percentage loading of drugs and the pH of the PBS solution medium. The drug-release profile of 5-fluorouracil exhibited a biphasic release with an initial burst release, whereas the release behaviour of isoniazid drug followed an *n*th order kinetic model.