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Chemical Papers 66 (5) 321–322 (2012)
DOI: 10.2478/s11696-012-0161-3

GUEST EDITORIAL

Ultrathin organic, inorganic, hybrid, and living cell coatings – Topical Issue

Recent years have witnessed a tremendous interest in the design, testing and application of thin and ultrathin organic, inorganic, hybrid, and living cell coatings. One reason for this widespread interest lies in the fact that thin coatings impart a wide range of properties encompassing adhesion and wetting; chemical, electrochemical, gravimetric, and optical sensing; response to external stimuli, bioactivity and anti-biofouling, catalytic activity, corrosion control, etc. However, the long-term stability and high performance of the deposited coatings cannot be achieved without the development of new, reliable chemical or radiation-induced strategies for attaching species to the underlying substrates.

Towards this end, this Topical Issue publishes reviews and original papers on ultrathin coatings by acknowledged experts from North America, Europe, North Africa, the Middle East, and Asia. They contribute with nine reviews and six original papers on the fine control of surface and interface chemistry in the design of high-performance materials and devices. The contributions have a broad span and fall within the scopes of:

– surface organic chemistry;
– electrochemistry and electro-catalytic nanomaterials;
– corrosion;
– plasma deposition;
– polymer grafting and polymer nanocomposites;
– sol–gel science and technology;
– biocompatible and bioactive materials;
– chemical and biosensors.

The team of Jie Zheng (pp. 323–339) describes the deposition of ultrathin polymer coatings for antifouling and biosensor applications with an emphasis on surface plasmon resonance (SPR) studies.

SPR is a surface analytical technique demonstrated by Benjamin Carbonnier and co-workers (pp. 340–351) as being efficient for developing optical sensors based on molecularly imprinted polymer (MIP) grafts. These are biomimetic coatings of growing interest in the general domain of analytical chemistry.

In another review on hydrophilic coatings, Teresa Basinska and Stanisław Słomkowski (pp. 352–368) stress the importance of designing polyglycidol-containing microspheres for biomedical applications.

Zakaria Salmi et al. (pp. 369–391) describe strategies for grafting polymers to metallic, carbon, diamond, semi-conductors, ceramics and polymers via the interfacial chemistry of diazonium salts. These compounds have been known in organic and dye chemistry for more than a century, but researchers have only recently used them to pave the way to new methods of polymer coatings.

Polypyrrole and polyaniline are among the conductive polymers most investigated. On the one hand, Mária Omastová and Matej Mičušík (pp. 392–414) provide a critical review on composite materials with polypyrrole coatings. On the other hand, the team of Jaroslav Stejskal (pp. 415–445) describes at length the role of infrared, Raman, and UV-VIS spectroscopies in studying the mechanisms of the formation of polyaniline coatings.

Petr Kluson and co-workers (pp. 446–460) provide a critical review of the chemical and physical deposition methods of thin titanium oxide. They discuss the physicochemical properties (e.g. wettability) and indicate applications for these ceramic coatings.

The team of Hasan Erdem Çamurlu (pp. 461–471) reviews the previous and latest fundamental studies on anti-reflective, self-cleaning, and multi-functional films based mainly on porous silica particle thin films coated with TiO_2.

Fakhradin Mirkhalaf and John Graves (pp. 472–483) present strategies and mechanisms for making nanostructured coatings for electrocatalysis. The emphasis is on the growing importance of aryl diazonium salts in the immobilisation of catalytic metallic nanoparticles on electrodes. Applications concern the oxidation of a range of molecules (e.g. methanol) and the reduction of oxygen.

As far as original papers are concerned, the group of Dinesh Aswal (pp. 484–491) employed molecular beam epitaxy (MBE) to deposit ultrathin films of cobalt phthalocyanine on glass and sapphire substrates. They investigated the morphology and charge transport characteristics of the thin films and demonstrated their efficiency in chlorine gas sensing.

Turning to inorganic coatings, Matilda Zemanová and co-workers (pp. 492–501) describe the depo-

sition of Ni–W thin coatings on mild steel substrates from aqueous electrolytes. These extremely hard coatings are known to have excellent resistance to wear and to corrosion. In particular, the authors demonstrate that the corrosion resistance in chloride medium is intimately linked to the compactness and high tungsten content of the Ni–W alloy coatings.

Mehrdad Nikravech and co-workers (pp. 502–510) concentrate on the original spray plasma technique to obtain porous layers of $La_xSr_{1-x}MnO_3$ as cathodes for fuel cells and nanostructured ZnO–Al layers to form transparent conductive cathodes for photovoltaic cells.

Sergey Kuznetsov (pp. 511–518) demonstrates the attractiveness of using molten salts for coatings deposition as an alternative approach to CVD, PVD methods, plasma, and detonation spraying. The paper then concentrates on the production of heat-resistant coatings from hafnium and niobium–hafnium alloys, and the electrochemical syntheses of copper–hafnium solder and HfB_2 coatings.

Karim Benzarti and co-workers (pp. 519–531) thoroughly investigate the role of the surface treatment of clay particles on the rheological and thermomechanical behaviour of clay–epoxy nanocomposites. This research is not only important in the general domain of nanocomposites but is also of interest in civil engineering and building technology. In the future, clay-reinforced epoxies could be used as coating materials with enhanced barrier performances, in order to protect infrastructures against environmental ageing or corrosion.

Whilst the four first reviews addressed the development of ultrathin coatings resistant to bacterial fouling or for the bio-recognition of bacteria and bacteria antibodies, the team led by Ali Othmane (pp. 532–542) close the Topical Issue by demonstrating that the immobilisation of thin endothelial cell films can be readily achieved on glass and ITO substrates through polyelectrolyte coupling agents. The cell coatings were characterised by cyclic voltammetry and impedance measurements and conclusions were drawn on favourable cell adhesion parameters for future tissue engineering.

From what has been briefly summarised in this Topical Issue, it is hoped that the reader will appreciate the various surface chemical, electrochemical and radiation-induced methods provided by the fifteen teams, experts in their own fields, to design a very broad spectrum of ultrathin coatings. State-of-the art and latest developments were described and cover various scientific horizons. We anticipate that this Topical Issue will highlight to the specialist and non-specialist alike the rich diversity of coatings and their immense potential in today's science and tomorrow's technologies.

Mohamed Chehimi
ITODYS, UMR CNRS 7086,
University Paris Diderot, Sorbonne Paris Cité,
15 rue J-A de Baïf, 75205 Paris Cedex 13, France,
E-mail: chehimi@univ-paris-diderot.fr