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Editorial

Polymer coatings are used for a wide range of applications: functional, protective and decorative. They account for a great deal of Materials Science activity. The Polymer Coatings research community is served well by several specialist journals but it is important that their activities also reach a wider readership and it is natural that publications appear in many non-specialist journals. We are pleased that many papers on Polymer Coatings are submitted to *Journal of Materials Science* and that we can provide a forum for this important area of Materials Science. To give this even more focus, the Editorial Board of *Journal of Materials Science* commissioned this Special Issue of the journal on Polymer Coatings, and I was invited to act as editor. I am happy to bring to the reader this collection of papers from a distinguished and international set of authors. The range of topics is just about as broad as can be contained within the notional boundaries that we set for the Journal.

The Special Issue begins with three Reviews. The first one, by Francis and co-workers, reviews the origins of internal stresses in coatings and the methods available to measure them. Internal stresses have an important, sometimes controlling, influence over behaviour and failure of coatings and this topic is visited in many of the research papers that follow. The second review, by Dušková-Smrčková and Dušek, presents a detailed analysis of the changes that occur in the coating as it solidifies, tracking the influences of crosslinking and solvent evaporation that are essentially independent yet are interactive because they occur simultaneously. The third review is by Hay and Khan on "Environmentally friendly coatings using carbon dioxide as the carrier medium", their own title capturing this new topic completely.

The first five research papers all extend areas covered within the first two reviews. Sangermano, Priola and co-workers consider the use of UV curing to control the kinetics of network formation to give the best mechanical properties in epoxide coatings. Zhao, Keddie and co-workers describe the inhibition of surface levelling of thermosetting polyester powder coatings caused by surface tension gradients during curing. Abdelkader and White describe studies of the effect of humidity on internal stress development during curing of solvent-free epoxy resin based coatings. If internal stresses are too high, coatings can either crack or delaminate. Handge presents an analysis of the crack patterns that form when large internal stresses are present in coatings, combining shear-lag theory with Weibull analysis. The problem of delamination of paint from a thermoplastic substrate is tackled by Tang and Martin. Following these papers, the general theme of mechanical properties of coatings is continued with a comprehensive characterization of the thermal and elastic constants of a UV resist by Feng and Farris.

The following papers relate to the tailoring of microstructure to achieve desirable properties. Duffy, Hsu and co-workers discuss the relationship between the interaction parameters and the phase behaviour, and hence morphology and properties, in high performance adhesives and coatings. This is followed by a paper by Akay and co-workers who show that a broad range of morphologies can be achieved through control of the processing conditions in specially designed equipment that causes flow-induced phase inversion in ethylene vinyl acetate copolymer. Papers on nanostructured materials come next, starting with one on nanoporosity and the manufacture of nanoporous foams for integrated circuit applications by Plummer, Månson and co-workers. Decker and co-workers describe the development of a solvent-free, UV-curing nanocomposite model material based on a polyurethane-acrylate matrix and a mineral, treated to make it organophilic; the authors confidently predict that their method could be used to make a wide range of nanocomposites with fillers with different functions. Kitazawa and Watanabe use a poly(methyl methacrylate) matrix to protect functional lead-based layered perovskite particles which, when unprotected, have poor thermal- and photo-stability, to produce composites with attractive photoluminescence and electroluminescent properties. Kado, Aoki and Miyasita describe a method to introduce a functional group into a polymer coating using reactive Langmuir-Blodgett films.

The theme of functional coatings is continued, first with papers concerned with optical applications. Qin, Fang and co-workers describe the development of nonlinear optical materials for optoelectronics, based on a novel guest-host system. Pan, Fang and co-workers are concerned with the thermal stability of corona-poled films. Suto and Hasegawa explore the origins of self-colouring of cholesteric liquid crystal films. Although the paper by Wang and co-workers is concerned with electrically conducting polythiophene coatings, the emphasis is on failure behaviour, with internal stresses once again identified as a possible source of problems.

Corrosion protection is a traditional application for polymer coatings, but the two papers devoted to corrosion protection here relate to very specialised uses. Sugama and co-workers describe the use of coatings with high temperature capability for the protection of carbon steel heat exchanger tubes in geothermal power plant operating up to 160°C. Levi and co-workers compare the mechanisms of protection and effectiveness of several surface treatments for high performance concretes.

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The long-term performance of coatings is of considerable concern, especially as their purpose is often to provide protection against an aggressive environment, often simply outdoor conditions. Accelerated testing is used extensively to assess the capability of new coatings or of existing ones in applications involving environments that they have not previously been exposed to, and the relationship between accelerated testing and service behaviour has been a recurrent theme for many years. A notable contribution in this field is given by Croll and Skaja. There is an ever-present quest for better methods for accelerated testing and Christensen, Egerton and co-workers have developed a method capable of very rapid assessment of the photodegradabilility of coatings.

The characterization of coatings is a vast and important subject in its own right, and many of the papers already mentioned above contain detailed and sometimes inventive characterization procedures. The final collection of papers place even more emphasis on the methods of characterization. Narayan, Raju and co-workers show how the combination of several characterization techniques provides a comprehensive analysis of cure, viscoelastic properties and mechanical properties, for hydroxylated polyester melamine high solids coatings. Nanoindentation is used extensively in the studies described by Beake and co-workers and by Briscoe, Adams and co-workers. This modern technique has been used more extensively with other classes of materials and its application to polymers is most welcome. Finally, another method more commonly associated with hard coatings, scratch testing, is applied to marine coatings by Bull and co-workers. With nanoindentation and scratch testing, ways of interpreting the measurements are still being developed for viscoelastic polymers, and it is expected that still more advances are just around the corner.

In assembling an Issue of this kind, it is necessary to work to a fairly tight schedule, otherwise the first papers to be submitted will be out of date before they go to press. I am grateful to the authors and our (unacknowledged) reviewers for their co-operation in keeping to the timetable, and also to the Editorial Office at Kluwer, and to Angela DePina in particular, in putting together this Issue.

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