EDITORIAL

The Crucial Role of Interfaces in a Wide Range of Materials Properties – an Opportunity for Research and Applications

This edition of CHIMIA reports on the '10th International Macromolecular Symposium at Interlaken', dedicated to *Surfaces and Interfaces of Polymers and their Importance to Materials Science and Engineering*. The organizers have attempted to prepare a well-balanced program in which fundamentals and applications are on par, and in which chemistry as well as physics is properly represented. They have succeeded in engaging an illustrious group of international speakers.

Between two phases or material states lies a layer with properties differing from those of the bulk material on either side. This layer is very thin, usually of a thickness of the order of several nanometers and is commonly abstracted to a geometrical surface – hence its name 'interface'. On the sub-nanometer length scale common to chemical considerations this 'skin' between homogeneous bulk materials is, however, thick enough to contain more than one molecular layer; it typically has variable chemical composition and super-molecular structure – this is true also when one of the materials is vacuum, that is, when we would call it a surface.

The interface behaves like a stretched membrane between the bulk materials – it displays interfacial or surface tension. It is also more or less resilient to separation and largely determines the macroscopic adhesion between the two materials. The transmission of mechanical deformation and stress between homogeneous domains in a material is largely determined by the interfaces and they control to a significant extent the mechanical behaviour and strength of micro-phase separated materials such as composites. The practical relevance of this cannot be overstated; most advanced materials are microscopically heterogenous and it is probably safe to say that the imminent future will see an intensification of development and use of microphase separated materials with heterogeneities on a smaller and smaller scale. Polymeric materials are no exception.

Often 'contaminant' chemical species agglomerate at the interface and modify its properties substantially, even when present only in small concentration with respect to the total volume of the sample. Furthermore, the interface is very often a mixture of chemical species and frequently, chemical transformations occur there readily since local concentrations are usually high. Hence, the interface is the determining factor for chemical stability and is especially relevant for a material's resiliance against thermal and environmental influences.

While the importance of interfaces for a wide range of properties has been recognised, detailed analysis of and control over their composition and structure is still possible only in the rarest of circumstances. Analytical tools sensitive to the interface with sufficient spatial resolution to yield chemically relevant structural data are almost completely absent and their results cannot be compared to the detailed information that can be gleaned from methods for homogeneous bulk phases. The most important problem here is the fact that very few atoms and groups exist at an interface compared to the large number present in the bulk. Nevertheless, during the last years new methods have been developed and well-known ones refined to the point where detailed information has become available to the chemist working with interfaces. The situation is similar with respect to the control of the interfacial structure. In general, there is little know-how that would lead one to be able to build well-defined interfaces, but in the last few years it has become possible, under special circumstances, such as the construction, molecular layer by molecular layer, of films on solid substrates by the *Langmuir-Blodgett* technique. These developments open completely new avenues towards controlling and understanding interfaces on polymers.

In light of the importance of phase-separated materials and the significance of interfaces to their properties, it is certainly opportune to invest effort and funds in the research and development of the analytics and basic chemistry, as well as in the physics and engineering of polymer surfaces and interfaces.

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