Advances in polymer matrix composites

The American Chemical Society divisions of 'Polymer Chemistry, Inc.' and 'Polymeric Materials: Science and Engineering' jointly organized a five day symposium at the April 1992 San Francisco ACS meeting on polymer matrix-based composites. The programme was organized by Dr James E. McGrath and Dr Cynthia Arnold-McKenna. A large fraction of the symposium papers have been transformed into manuscripts and subjected to the normal rigorous *Polymer* reviewing standards. A total of 33 manuscripts have thus been generated for this special issue of *Polymer*.

There are a variety of reasons for strong interest in polymer matrix composites and related structural adhesives. Polymer matrix composites can provide the greatest strength-to-weight and stiffness-to-weight ratios available in any material, significantly greater than even the lightest, strongest metals. Hence, high performance and fuel economy-driven applications are best served by the use of such composites. One of the most important aspects here is the opportunity to design various critical properties to suit the intended application. Indeed, performance may be controlled by altering the constituents, their geometries and arrangement, and the interfaces between them in the composite systems. This makes it possible to 'create' materials tailored to applications; the single greatest advantage and future promise of these material systems. Structural composites have already proven themselves admirably in aerospace applications, such as aircraft, and in numerous selected industrial and consumer uses. The advantages include light weight, high strength, fatigue life, and corrosion resistance. However, there is still much that needs to be done to advance processability and durability, in order to provide a more comprehensive data base and to improve the economics of these systems. Thus, this special issue discusses synthesis, characterization, processing, testing, and modelling of important polymer matrix composite systems.

In general, the future of polymer matrix composites is very bright. The engineering community is in the second generation of applications of composites, and primary structures are now being designed with these materials. There is a growing confidence in the reliability and durability of polymer composites and a growing realization that they hold a promise of economic, as well as engineering, gain. Commercial programmes such as high speed civil transport will not succeed without the use of polymer composites. Integrated synthesis, processing, characterization and modelling are bringing us to the point where we can use molecular concepts for the design of the material system, and also estimate how the way in which materials are put together affects the performance, economy, and reliability of the resulting component. The future will undoubtedly bring more of this precise understanding to the marketplace, especially in the form of wider variations in available materials. Integration of our materials understanding into the manufacturing, processing, and component design steps will greatly accelerate the acceptance of these advanced materials. New horizons of properties and performance, such as smart and intelligent materials, actuators, sensors, high temperature organic materials and multi-component hybrid systems, will have the potential to introduce a new age of economic success and technical excellence.

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