Conducting Polymers

There follows a few remarks on the subject of the five articles grouped together in this issue dealing with electronic aspects of polymers.

Traditionally, high polymers have a structural role in materials science. The continuity provided by the valence bonds between the large number of atoms constituting chain molecules endows materials made thereof with uniquely special properties, such as long range elasticity, the basis of elastomers, spinability, the basis of fibres, which in turn display high stiffness and strength, and so on. The latter are all familiar in materials applications paralleling the similar structural roles played by appropriate biological molecules (e.g. cellulose, silk, chitin) in living organisms which in fact the synthetic materials set out to emulate initially. Continuing this parallel, in living systems the long chains not only serve to provide a structural framework holding the system together and giving it protection, but also and chiefly, to ensure the coding and transmitting of information, in ultimate analysis through the intricacies of the electronic features of the molecular constituents. In the same way, synthetic materials provide analogous opportunities in service of man designed functions. The prospects for the latter are now well recognised and form the subject of research world wide of which the group of articles in this issue are a few, yet representative examples.

The first, a review article by Feast and Friend sets the scene to what is involved in making the electrons in a polymer perform desired functions, in the first instance to conduct electric current. The latter, as long anticipated but not realized until recently, involves the delocalization of some of the electrons forming the chemical bonds. As will be apparent from the review the realization of this goal involves intimate interaction between the disciplines of Chemistry and Physics in designing, synthesizing and finally utilizing such materials to optimum advantage. Amongst much else it reveals two presently largely incompatible requirements: processability and physical performance, the pursuit of which places the subject firmly in the realm of materials science. The realization of much of the intrinsic promise of polymers as conductors depends on the overcoming of these difficulties. Towards this, the authors themselves have made salient advances, together with significant contributions to device applications, both aspects contained in the review.

Two of the contributed papers (by Eales and Hillman, and Cheung *et al.*) are concerned with one of the most promising approaches to the creation of conducting polymer systems, namely the route of electrochemical synthesis, a subject area which has arisen in response to new demands and opportunities. Here, traditional and synthetic electrochemistry become closely fused, coupled with appropriate analytical, mainly spectroscopic, techniques. A further, all important factor apparent here, just as in the preceding review and in the paper from Bristol to follow, is the overriding role of the morphology which forms the bridge (or a gap, whatever the case may be) between the molecular and the macroscopic. Much further research is required in this latter direction, some pointers to which are being provided.

The Bristol paper (Kanazawa *et al.*) is one example on the formation of a conducting polymer in the solid crystalline state of the monomer, in this case of $(SN)_x$ which has originally attracted much attention due to its superconducting properties. While interest in the latter feature has waned since the advent of high temperature superconductors, $(SN)_x$ is still the only polymer which does not require doping for a respectable level of conductivity. For this, and for the insight it secures into solid state polymerization reactions, including discrimination between interior and surface, it still deserves continuing attention.

Finally, the theoretical paper by Honeybourne is probing the molecular prerequisites for producing molecular structures for intended electro-optical applications. The main issue here is non-linear optical behaviour, a major quest world wide in aid of signal processing devices. The aim is to identify molecular entities with desirable properties for incorporation into polymeric systems either chemically (attached to the chain) or physically. An experimental study by Honeybourne and Buckley with related objectives is contained in the September Letters edition of this journal on page 993.

In concluding, it is hoped that these few papers will provide a kind of microcosm of this most topical, forward looking (both scientifically and practically) exciting subject area.

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