ADVANCED MATERIALS

Speciality Polymers

The 3rd International Conference on New Polymeric Materials, "Speciality Polymers '88", was organized by the journal *Polymer* and held from September 13–15, 1988 at Queens' College in the beautiful old university town of Cambridge, UK. About 350 participants attended to hear about the newest developments in the field, which were presented in six plenary lectures and two parallel sessions with 22 papers each, devoted to "High Performance Polymers" and "Electroactive Polymers", respectively.

In the first plenary lecture *D. T. Clark* (ICI, UK) discussed approaches to meet the development goals for high temperature performance polymers for air- and spacecraft applications: The T_g/T_m window of aromatic polyetherketones-co-sulfones can be adjusted by suitably balancing the sulfone and keto group content, with high keto content generally giving rise to high T_m, while increasing the sulfone content lowers the degree of crystallinity. The fine control of properties depends on a number of additional parameters, amongst which the sequence and isomer distribution are of major importance for the crystallization behavior and morphology, with the effective sulfone content of the interlamellar phase controlling the T_g.

From the number of papers devoted to electrically or optically active polymers, and the high innovative content of the presentations, it became clear that the bias of this session was towards polymer systems with highly sophisticated optical and/or electro-optical properties. The rich diversity of structural types of liquid-crystalline (LC) polymers, studies on their structure-property relationships, and various efforts to tailor their optical or electro-optical response for particular applications, were reviewed by *G. M. Gray* (University of Hull, UK). Taking siloxane and acrylate LC polymers as examples, it was stressed that analytically pure materials, with respect to precursor removal, molecular weight and dispersibility, are essential in order to obtain reproducible results on transition temperatures, dielectric properties, elastic constants and electro-optical response. To meet the challenge of the search for LC polymers with non-linear optical (NLO) properties, *Gray* and his coworkers have introduced a new type of LC copolymer with conventionally and laterally attached rod-like mesogens. LC side-chain polymers based on siloxanes or acrylates with birefringent, dichroic, fluorescent and NLO properties were discussed by *H. J. Coles* (University of Manchester, UK). Special consideration was given to nematic and smectic, and also ferroelectric phases, and optical effects as fast as 10^{-9} s with lateral resolution of about 10^{-6} m have been demonstrated in such systems. The kinetics of the alignment process in LC side-chain polymers can be studied by dielectric relaxation spectroscopy, as demonstrated by *G. Williams* (University of Wales, Aberystwyth, UK).

The diacetylenes, which offer a great variety of primary structures, are very promising as NLO materials and, because they can be laid down as ultrathin layers using the Langmuir-Blodgett (LB) technique, as candidates for integrated optics; accordingly they were discussed by several speakers. An alternative to LB films derived from diacetylenes, which have to be post-polymerized, are LB films from preformed polymers based on substituted acrylates with mesogenic side chains, as described by *P. Hodge* (University of Lancaster, UK). Symmetric as well as noncentrosymmetric LB multilayers can be assembled by using two or more different polymers. Second Harmonic Generation (SHG) in spin-coated PMMA films containing azo dyes was discussed by *Le Barny* (Thomson-CSF, France).

The development of "photonic computing" based on optical shutters, logic elements and storage elements requires materials with very fast (10^{-12} s) switching times, as was outlined by *R. S. Potember* (Johns Hopkins University, USA). The only processes in organic molecules that are fast enough for this purpose are electronic level jumps or polarizability changes. As an example the excitation of π-states in ladder type oligomers with an indanthrone type backbone was discussed, with the optical response varying dramatically according to the type of substitution and degree of polymerization. A final link between diacetylenes and LC materials was offered by *M. A. Schen* (National Bureau of Standards, Gaithersburg, USA), who reported on the polymerization of diacetylenes from a smectic c-phase, in which the activation energy for thermal polymerization was considerably lower than that in the crystalline phase.

The common features of electroactive polymers, and the influence of molecular or supermolecular defects on their performance as conducting, charge-storing, piezo- or pyroelectric materials were reviewed by *T. J. Lewis* (University College of North Wales, Bangor, UK). The concepts of charge transport involving localized states, tunneling structures and the influence of interfaces and phase boundaries in the solid state of conducting materials were discussed.

The contribution by *P. Kathirgamanathan* (Cookson, UK), entitled "The Future of Conducting Polymers" was expected by most of the participants to clear up some of the uncertainties in this particular field. Since the review of the present situation in conducting polymers took up all the available time, the speaker unfortunately did not reach the discussion of their future. However, the future of conducting polymers was touched on in a number of contributions, which dealt with the problems of processing such materials: *P. Smith* (University of California, Santa Barbara, USA) reported on the synthesis of polyacetylene (PA) in a polyethylene gel, from which it could be drawn into highly anisotropic fibers. *R. W. Lenz* (University of Massa-

chusetts, Amherst, USA) reported on a new route to poly(arylene-vinylenes) from polyelectrolyte precursors. Since the precursor polymers are easily soluble, they can be processed into films etc. prior to converting them thermally into conducting materials. While the "Durham route" to PA has become acknowledged as the prototype for precursor routes to conducting polymers, no such route is yet working satisfactory for poly(*p*-phenylene). *J. Feast* (University of Durham, UK) introduced a new approach via a Pd-catalyzed polycondensation of boronic acid derivatives of appropriate phenylenes, to yield side-chain substituted poly(*p*-phenylenes), which are soluble. Future prospects for the application of conducting polymers were reviewed by *J. H. Burroughes* (University of Cambridge, UK), who has succeeded in assembling a MIS-FET transistor using polyacetylene made by the Durham route.

Ionic charge transport in polymers was addressed by *S. A. Dobrowsky* (University of Leeds, UK), who has investigated *N*-substituted poly(acrylamides) as a matrix for inorganic salts to form ionically conducting polymer-salt complexes. *A. Gandini* (École Française, Paris) reviewed polymer-salt complexes with polyethyleneoxide or polypropyleneoxide networks as the matrix. In the polymer-salt complexes the glass transition behavior is found to be the dominant feature determining the ion transport properties. This seems not to be the case in polyelectrolyte glasses based on polymeric ammonium salts ("ionenes"), whose molecular dynamics and dielectric properties were compared by *G. Wegner* (Max-Planck-Institute for Polymer Research, Mainz, FRG).

It was due to the exceptionally interesting presentations that "Speciality Polymers '88" became a very successful meeting for materials scientists.

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