to large-scale MeV facilities with high current densities. Unfortunately, the topic of increasing the wear resistance of metals and ceramics by ion implantation was not addressed at all.

The symposium on "Preparation and Properties of Metastable Alloys", organized by *K. Samwer*, FRG, *M. von Allmen*, Switzerland, *J. Bottiger*, Denmark, and *B. Stritzker*, FRG, dealt with the thermodynamic aspects of metastability, the amorphization of crystals, the preparation and nucleation of undercooled liquids, the relaxation of amorphous matter, quasicrystals, ion beam modification, and the properties of metastable alloys. Although these topics seem to be rather exotic they are of high relevance not only for scientific insights but also for economic reasons; many industrial processes such as the preparation of superalloys, amorphous metals or thermodynamically impossible compounds will be able to employ such methods as powder atomization, tape casting or melt spinning to create new materials with potentially attractive properties if the basic problems of, e.g., nucleation and reaction kinetics, are understood.

Since all four symposia covered nearly every type of material from metals to ceramics, as well as all methods of preparation and characterization, all the sessions were equally attractive for the attendees. The meeting was therefore also an important opportunity to make contact with diverse groups of specialists in order to discuss new points of view and to consider unconventional strategies for solving particular problems. On the other hand, the mixing-up of related topics in four or even six parallel sessions does not permit a suitable choice of lectures without hurrying along the corridors searching out the particular room for the next session, a procedure which is even more difficult if the time schedules are not rigidly followed.

One of the advantages of this E-MRS conference was that many speakers could take part who do not normally have the opportunity to present their research in a genuinely international forum. Moreover, for many "junior scientists" Strasbourg was a very first opportunity for an international debut oral presentation before a highly expert audience; this was recognized by awards for the best presentations.

Amongst the many new competing, profit-oriented and routinely organized conferences on materials science, the merit of the annual E-MRS meeting is that it appears to be a forum specifically for European researchers—though, of course, also open to non-European attendees. The organizing committee should go on with its encouraging efforts by making further use of the charming atmosphere of the city of Strasbourg for the Fall meeting to be held on November 8-10, 1988.

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Research News

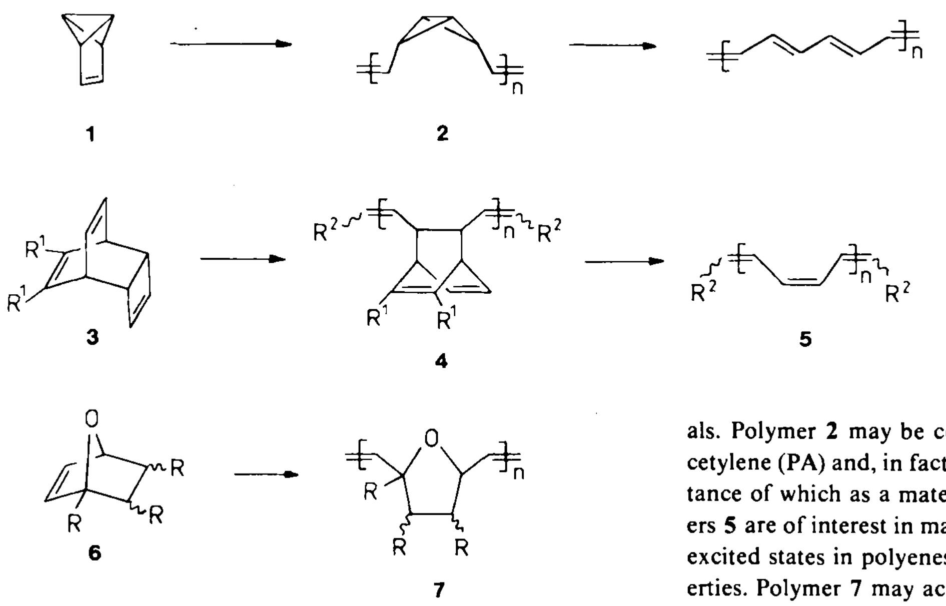
Ring Opening Metathesis Polymerization—Recent Developments

Ring opening metathesis polymerization (ROMP) originated in the late fifties and mid sixties when *Anderson*, *Dall'Asta* and *Natta* showed that strained cyclic olefins polymerize with breaking of the CC double bond in the presence of transition metal catalyst systems.[1] These observations initiated the growth of a whole area of research which is now known as ROMP, and led to the commercialization of new hydrocarbon polymers such as Vestenamer (Hüls), Norsorex (Chimie de France) and Metton (Hercules).

Research initially concentrated on the scope and mechanism of the polymerization. During this process a measure of control of microstructure and molecular weight was obtained. After several false starts[1] the consensus favoured a chain growth mechanism with an alternating metallo-carbene/metallacyclobutane as the chain carrying species. This hypothesis was fully confirmed by *Grubb*'s elegant work with titanacyclobutane initiators.[2] This work of *Grubbs* et al. also initiated an exciting new phase in this research area by establishing well-defined, living metathesis polymerization. *Osborn* et al.[3] and *Schrock* et al.[4] have also described such well defined initiators.

The catalyst acidity is critical in these polymerizations, both if monomers tend to undergo electrophilically induced rearrangements and if monomers contain nucleophilic heteroatoms which may coordinate to the metal center and lead to undesired side reactions or poisoning of the catalyst. Thus, these novel, fine-tuned initiators significantly widen the variety of monomers susceptible to ROMP. Some examples of the recent achievement in this area are briefly described.

The tungsten complex $[\mathrm{W}(\mathrm{O}t\mathrm{Bu})_2(2,6\text{-}i\mathrm{Pr}_2\mathrm{C}_6\mathrm{H}_3\mathrm{N})(\mathrm{CH}t\mathrm{Bu})]$ turned out to be specific enough to open the CC double bond of benzvalene **1**, while leaving the sensitive bicyclobutane moieties untouched.[5] The same complex opened



monomer **3** in a controlled manner to a set of oligomers **4**, which, after end capping and fragmentation reactions, were converted to separable polyenes **5**, with seven to fifteen double bonds.[6] Finally, a variety of substituted 7-oxanorbornenes **6** were shown to polymerize to high molecular weight compounds in the presence of $[W(OCH_2tBu)_2(CHtBu)Br_2]$, a similar tungsten catalyst. The importance of the nature of the catalyst was proven by subsequent addition of more electrophilic catalysts to polymer **7**, when complete cleavage of 1,4-epoxy units was observed.[7] These monomers may also be polymerized by ruthenium based initiators like "$RuCl_3 \cdot 3H_2O$" in the presence of water.[8]

The ROMP products **2**, **5** and **7** have entirely novel structures and are inaccessible by other methods. These polymers are not only interesting from the view-point of basic research but show remarkable properties as materials. Polymer **2** may be considered as precursor for polyacetylene (PA) and, in fact, was rearranged to PA the importance of which as a material is evident. Separated oligomers **5** are of interest in many respects, e.g. those concerning excited states in polyenes or their non-linear optical properties. Polymer **7** may act as an acyclic ionophore or as an ion permeable membrane. Thus, the new generation of ROMP catalysts has opened the way to a whole variety of novel polymers more of which might eventually gain industrial importance.

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Book Reviews

Carbon Materials

Carbon—Electrochemical and Physicochemical Properties. By *K. Kinoshita.* Wiley, New York 1988. xiii, 533 pp., bound, £ 65.00.—ISBN 0-471-84802-6

Carbon materials have been used in electrochemistry for several decades, both in laboratory apparatus and in industrial plants. In many of the applications there is no competition whatever from other materials. The large potential range, wide variety of morphology, good corrosion resistance, high electrical and thermal conductivity and reasonable costs all contribute to carbon's benefit in electrochemical systems. Moreover, new types of materials such as pyrolytic graphite, glassy carbon and carbon fibers, have further extended the range of applications. However, many users today are not fully aware of the wide variety of carbons that can be produced by different manufacturing processes and—most importantly—neither do they know the individual physical and chemical properties of these forms. This lack of knowledge makes it difficult to