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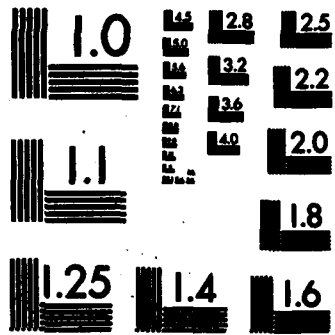
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ELASTOMERS AND OTHER ORGANIC COMPOSITES

FINAL REPORT

J. E. MCGRATH, G. L. WILKES, D. G. BAIRD, T. C. WARD, D. W. DWIGHT

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The objective of this program was to bring together five investigators whose expertise was in the area of polymer synthesis, characterization, rheology and processing, solid state morphology and mechanical behavior and surface science. This abstract will describe some highlights of research findings and potential applications. In addition, in an appendix we have included statistics on publications, preprints and theses.		

Butadiene-isoprene copolymers and their hydrogenated derivatives were examined. It was demonstrated that the block copolymers could be designed to provide a balance of chain scission and crosslink degradation behavior. This may be important in a variety of applications including vehicle treads. The block isoprene copolymers were also hydrogenated to yield interesting semi-crystalline thermoplastic elastomers. Fundamental aspects of anionic polymerizations have been studied which allow the control of molecular weight, molecular weight distribution and functional end groups. Such intermediates have promise for the synthesis of new elastomer components including possibly hybrid polyurethane cast pads that would have selective surface structure. Soluble difunctional initiators which can be used as intermediates to elastomers and polyols have also been studied.

Liquid crystalline copolymers are of great current interest and have already been demonstrated to be important reinforcing fibers for both elastomers and composites. This study has principally dwelt upon the relationships between chemical structure, rheology, morphology, and mechanical behavior. In addition, thermotropic polyesters and their blends with conventional PET have also been examined and show promise as advanced materials.

Inverse gas chromatography (IGC) has been used to probe polymer coatings with a variety of organic liquids as the mobile phase. Depending upon the relative retention times, important thermodynamic behavior can be derived. This has applications in the swelling of polymers and elastomers and also in the transport of agents through solid polymeric films. A second important technique that has been studied and further developed by this research is solid state NMR. This method has the ability to identify and define chemical structure and possibly molecular motion in elastomers, glasses and various network structures.

Polyisobutylene ion containing copolymers containing sulfonate end groups were investigated. Trifunctionality allowed for excellent mechanical properties as a combined result of ionic associations and strain induced crystallization. The ionic reinforcing phase could lead to new elastomeric materials with interesting transport properties that could possibly catalyze the decomposition of liquid agents.

Copolymerization of dimethyl and trifluoropropyl methyl siloxane elastomers systems shows promise for producing a low glass transition temperature (-60°C) that can be designed to show low swelling in hydrocarbons. Cycloaliphatic linked urea copolymers were synthesized which were transparent candidates for light stable elastomeric coatings. Additional work has been done in identifying and developing chemistry for matrix resins. A dielectric unit has been constructed which will be suitable for monitoring the cure or network formation for a variety of thermosets. These would include polyimides, epoxys, and elastomer networks.

Finally, extensive research has been conducted in the area of surface science which has included ESCA, SEM, and EDAX type techniques. There has been extensive instrumentation development and currently a Kratos-unit is operative. Information on the composition of surfaces versus bulk in elastomers and composites has been generated. This information has wide applicability with respect to elastomer or composite properties and systems such as tank treads. It can identify variations in compounding and also in surface oxidation by comparing, for example, oxygen to carbon ratios before and after various experiments. The general area of applying surface science to failure mechanisms has been developed significantly in this period and several good applications have been identified.

APPENDIX

(A) Publications

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2. Co-Editor, "Photo, Electron and Ion Probes of Polymer Structure and Properties", ACS Symposium Series, No. 162 (1981).
3. Editor, "Ring Opening Polymerization: Kinetics, Mechanisms and Synthesis", ACS Symposium Series, in preparation, 1984.
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