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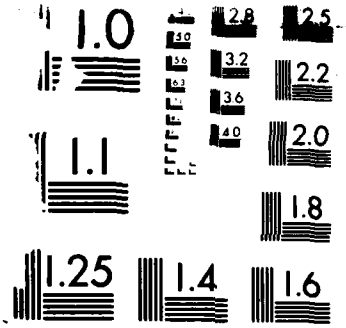
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Polymer Surface Tension, Interfacial Tension

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Preliminary results of studies of polymer surface and interfacial tensions are described. These properties have been measured for immiscible binary blends, rubber modified epoxies, and functionally terminated poly(dimethyl siloxane oligomers, using a novel apparatus for video image analysis of pendant fluid drop profiles. In addition, the surface structure of miscible blends of poly(vinyl methyl ether) and polystyrene have been measured by angle-resolved x-ray photoelectron spectroscopy experiements.

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CHARACTERIZATION OF POLYMERIC SURFACES AND INTERFACES

FINAL REPORT

JEFFREY T. KOBERSTEIN

October 1, 1986

U. S. ARMY RESEARCH OFFICE

Contract DAAG29-85-K-0245

PRINCETON UNIVERSITY

During the first year of this contract, the principal investigator changed his affiliation from Princeton University to the Institute of Materials Science of the University of Connecticut. This final report therefore reflects the progress attained during the first nine months of the research contract. A number of significant goals were attained during this period. One of the most important accomplishments was completion of an apparatus and associated computer algorithm for the determination of polymer surface/interfacial tension by video image analysis of axisymmetric fluid drop profiles. This development was a joint collaboration with researchers from AT&T and the University of Washington and a manuscript desribing the algorithm has been submitted for publication to the Journal of Colloid and Interface Science.

The algorithm for shape analysis and modeling of subsequent polymer interfacial tension data was also the subject of a presentation at the Conference on Organic Plastics and Coatings in Athens, Greece (July,1986). The temperature and molecular weight dependence of interfacial tensions for the immiscible blend poly(dimethyl siloxane)/polybutadiene were measured and compared to the predictions of current thermodynamic theories. Interfacial tensions were also measured between carboxy terminated acrylonitrile-butadiene rubbers and epoxies. The goal of this work is to correlate interfacial tension with particle size in rubber toughened epoxy resins. Preliminary results indicate that the systems with lowest interfacial tensions produced the smallest rubber domains, and a manuscript describing the work is currently under preparation.

Progress has also been made on the characterization of preferential surface adsorption effects in multiconstituent polymer systems. The effect of end goup concentration and type on surface tensions of poly(dimethyl siloxane) oligomers has been measured. It is interesting that if the end-goup is highly polar, the molecular weight dependence of the surface tension is actually reversed, to decrease with increase in molecular weight. Surface excesses in miscible polymer blends is being investigated by performing angle-resolved x-ray photoelectron spectroscopy experiments in collaboration with researchers from Xerox corporation. For blends of polystyrene with poly(vinyl methyl ether) below their upper critical solution temperature, the latter polymer is found to adsorb preferentially at the surface due to its lower surface energy. Enrichment of the surface is augmented for PVME specimens with higher molecular weight consistent with the fact that surface energy is inversely related to molecular size. The concentration profiles obtained from these results correspond well to a hyperbolic tangent profile as predicted by mean-field theories. A preliminary manuscript detailing these findings has been completed.

Student Support

The contract provides support for two PhD candidates: Mr. S. Anastasiadis and Mr. Q Bhatia. In addition, the contract provided support for the senior thesis of Mr. P. Thompson.

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