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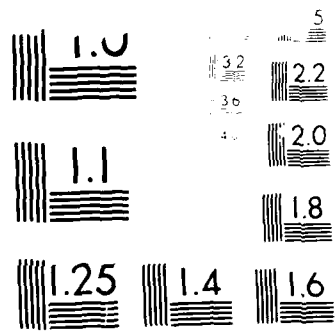
DEVELOPMENT/APPLICATIONS OF FT-IR ATR (FOURIER  
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FINAL REPORT

Development/Applications of FT-IR ATR  
and Photoacoustic Dichroism Techniques  
for Structural Characterization of Polymer Surfaces

by

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The ability to alter the angle of incidence accurately with the new ATR apparatus allowed depth profiling from about 1 to 15 microns. The results revealed some subtle changes in orientation and crystallinity as a function of depth on the surface of uniaxially drawn polypropylene (5).

In order to overcome beam divergence and back reflection due to non-integer reflections with face-cut crystals when a wide range of incidence angles is used, as in depth-profiling, a new ATR attachment using a hemispheric crystal had been designed. In this attachment, the sample is held against the crystal surface at a fixed point in space. The goniometer has been designed so as to rotate the crystal horizontally as well as vertically. Under this condition, the resulting beam after a single reflection is always parallel at a precisely known angle of incidence with a constant incident beam energy, regardless of the incident angle. A preliminary study showed promising results (7,8).

In FT-IR PAS dichroism studies, we were able to obtain three dimensional orientation measurement by tilting the sample ( $45^\circ$ ) in a specially designed PAS cell. The experimental data will be analyzed by extending the theory for the photoacoustic effect on solid surfaces to anisotropic solids.

While we continue to improve and develop new ATR and PAS attachments, our first ATR attachment has been adopted by many laboratories in the world, (e.g. 3M, Rhone-Poulenc, ICI, National Research Laboratory of Canada, University of Washington). Our 3-D ATR attachment has been adopted by Monsanto. They are being used to characterize a variety of polymers and composites such as PEEK and liquid crystalline polymers.

## PUBLICATIONS, TECHNICAL REPORTS, THESES

1. "Surface Chemical Composition - Depth Profile of Polyether Polyurethaneureas as Studied by FT-IR and ESCA", C. S. P. Sung and C. B. Hu, ACS Polymer Preprints, 21-1, 156 (1980); also issued as Technical Report No. 1.
2. "Comparison of Crystallinity and Molecular Orientation between Surface and Bulk of Some Polymers by FT-IR ATR and Transmission Spectroscopy" ACS Org. Coatings and Plastics Chem. Preprint, 41-1, 734 (1980); also issued as Technical Report No. 2.
3. "A Modified Technique for Measurement of Orientation from Polymer Surfaces by Attenuated Total Reflection Infrared Dichroism", Macromolecules, 14, 592 (1981); also issued as Technical Report No. 3.
4. "Orientation Measurement from Polymer Surfaces using FT-IR Photoacoustic Spectroscopy", Appl. Spect., 36, 257 (1982); also issued as Technical Report No. 4.
5. "Characterization of Surface Structure and Orientation in Polypropylene and Polyethylene Terephthalate Films by Attenuated Total Reflection IR Dichroism Studies", Macromolecules, 16, 193 (1983); also issued as Technical Report No. 5.
6. "Development of FT-IR Attenuated Internal Reflection Dichroism Techniques for Structural Characterization of Polymer Surfaces", Chem. Eng. Comm., 30, 299 (1984); also issued as Technical Report No. 6.
7. "Recent Development of FT-IR ATR Dichroism Techniques for Structural Characterization of Polymer Surfaces" ACS Polymer Preprints, 25-2, 154 (1984).
8. "Development of Two Novel Infrared Techniques for the Surface Characterization of Polymer Films", J. P. Hobbs, Ph.D. Theses, Dept. of Materials Science and Engineering, M.I.T. Jan. (1985).

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