Abstract No. Hyet0598

Synchrotron FTIR Microscopy and Photoacoustic depth profiling of Polymer Laminates

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Introduction: Photoacoustic (PA-FTIR) depth profiling is a non-destructive experimental technique for probing the chemical microstructure in the vicinity of the surface. The technique is often applied to well-defined polymer laminate films. However, its applicability to finely divided laminate samples is less clear. In order to test the applicability of the PA-FTIR depth-profiling technique to finely divided polymer laminates we require a microscopic technique with sufficient spatial resolution and which will provide identical information to the PA-FTIR experiment. Synchrotron FTIR microscopy seems an ideal candidate.
The system chosen is a solid support resin used in combinatorial chemistry. The resin consists of a cross-linked polystyrene (PS) core encased in a covalently attached shell of polyethylene glycol (PEG) terminated with a functional group upon which chemistry can be performed to attach the reaction adducts for the synthesis. The PEG shell also provides a hydrophilic environment to facilitate certain classes of organic reactions. The laminate nature of the resin micro-spheres (90-120 microns in diameter) makes them ideal candidates for the depth profiling experiment.

Methods and Materials: No special sample preparation is required for the photoacoustic measurements. However, in order to make use of the synchrotron FTIR microscopy the samples must be sectioned to a thickness of about 10 microns. The beads were embedded in melted paraffin, cooled and then sectioned with a microtome at –30ºC. The resulting sections were 10-12 microns thick and contained many circular beads of the right size to have been sectioned near the middle of the bead.

Results: the photoacoustic depth profiles and the synchrotron FTIR microscopy data are in full agreement. The synchrotron data confirm that outer PEG shell is 5-8 microns thick and the distinctive laminate structure seen in the photoacoustic data is the real configuration of the sample.

Conclusions: With the synchrotron FTIR microscopy data we have confirmed that the photoacoustic depth profiling experiment is a powerful tool for the analysis of all types of laminate samples, from polymer films to finely divided powders.

Acknowledgments: the authors would like to thank Dr. Nebojsa Marinkovic of U10B for his help during the synchrotron measurements as well as the Canadian Light Source PRT at U10B without which these measurements could not have been completed.