



Fiber Optic High Pressure Sensor



Barry Long, Juniata College
Dr. John Ferguson, WPAFB/AFRL-MLPB

U.S. AIR FORCE

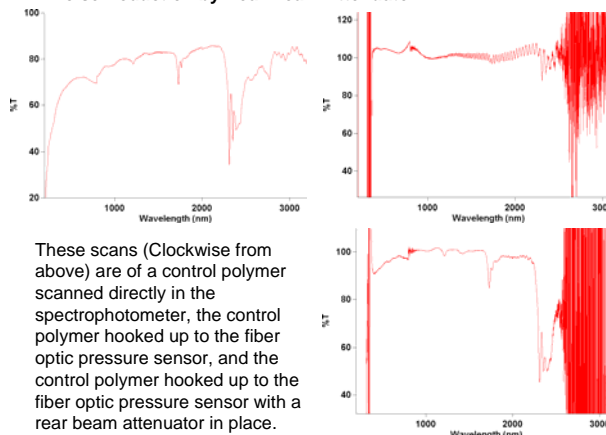


Purpose: To build a fiber optic coupling from a spectrophotometer to a diamond anvil cell to observe absorption shifts in star polymers.

A spectrophotometer (Varian, Cary 5000) is used to measure absorption and transmission of light through a material at differing wavelengths. A fiber optic coupler (Harrick, FiberMate) was used to let the light pass through a diamond anvil cell (High Pressure Diamond Optics, Inc.) which would not otherwise fit within the spectrophotometer. To optimize the transmission signal, the optical fibers (Ocean Optics, P600-2-Vis/NIR) were attached to fiber optic lenses on adjustable mirror mounts. To improve the signal-to-noise ratio, a rear beam attenuator as added to the secondary beam of the spectrophotometer to balance the transmission lost going through the fiber optic coupler.



Noise Reduction by Rear Beam Attenuator



These scans (Clockwise from above) are of a control polymer scanned directly in the spectrophotometer, the control polymer hooked up to the fiber optic pressure sensor, and the control polymer hooked up to the fiber optic pressure sensor with a rear beam attenuator in place.

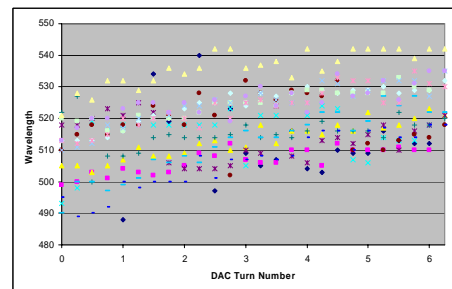
The following polymers were made by drop casting them in a glove box:

- 99% Polycarbonate, 1% hP-pT
- 99% Polycarbonate, 1% hTPA-pT
- 99% PMMA, 1% hP-pT
- 99% PMMA, 1% hTPA-pT



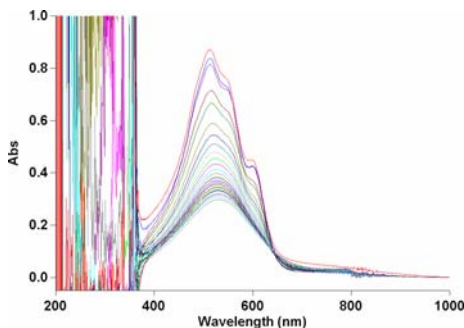
Each of the samples was placed in the diamond anvil cell and pressure was applied by turning the wheel on the cell in quarter turn intervals. Wavelength scans were taken while adding pressure on a fresh sample, while removing the pressure, and adding the pressure again. This was done to see if there is a hysteresis effect on the spectra. Although the largest peak remained visible for all, smaller peaks in the hP-pT samples faded as pressure increased and did not return when pressure was released.

Changes in Wavelength by Increase in Pressure

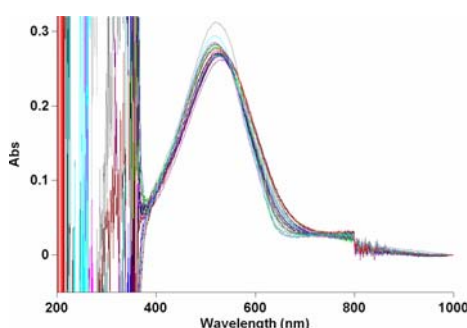


This chart shows the changes in wavelength as pressure is increase for all of the samples created.

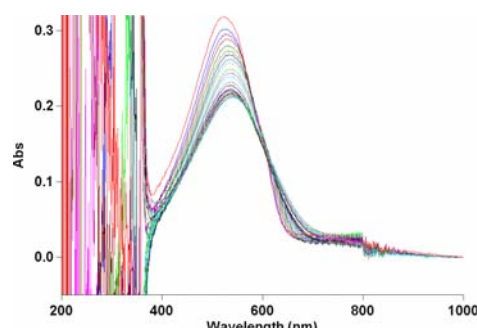
99% PMMA, 1% hP-pT



These scans were taken by applying pressure to a fresh sample.



These scans were taken when pressure was removed.



These scans were taken when pressure was reapplied to the sample.

Acknowledgments for support and funding:



National Science Foundation



Physics REU Program



Department of Defense