422a Studying Thin Polymer Films under High Pressure Carbon Dioxide Using the Quartz Crystal Microbalance

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Continuing interest in carbon dioxide as an environmentally benign solvent has resulted in a search to identify areas where CO2 can be utilized. Applications under investigation include: photolithography, drug impregnation, and nano-particle formation. In applications where polymers are being used, high pressure CO2 induced phenomena such as swelling and sorption have important consequences during materials processing.

To be able to effectively predict polymer behavior in the presence of CO2, mathematical models must be developed to describe the changes associated with different CO2 conditions. This project focuses on model development to describe swelling, sorption, and diffusion kinetics of CO2 and other gases into polymers over a wide range of conditions.

In this talk, we present research on the adsorption of CO2 in poly(methyl methacrylate), PMMA, films studied using the Quartz Crystal Microbalance (QCM). Data will be shown on the sorption/desorption of CO2 into/from PMMA films. Methodologies used to separate competing QCM responses (e.g., pressure, viscosity) to obtain CO2 mass absorbed by the polymer will also be presented. In the case of thin films, special analysis is utilized to incorporate the role of surface phenomena in the model. There is evidence of negligible surface roughness changes due to sorption/desorption. A comparison between the model developed and experimental data incorporates both equilibrium and kinetic data to describe the mechanisms of CO2 interaction with the polymer film.