Infrared Spectroscopy of Selenium Dioxide and Mineral Oil under Pressure

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Overview

Previous studies, using synchrotron radiation, indicated a phase change of selenium dioxide may occur between 0.4 GPa and 0.7 GPa.

We investigated selenium dioxide and mineral oil with Fourier Transform Infrared Spectroscopy (FTIR) in order to explore phase changes of selenium dioxide. We also monitored the effect of pressure on mineral oil infrared (IR) spectra.

Experimental Approach

Diamond Anvil Cell

Pressure was applied to selenium dioxide and mineral oil in a diamond anvil cell (DAC), ranging from 0.1 GPa to 8.0 GPa.

Ruby microspheres were included in the DAC for calibrating the pressure.

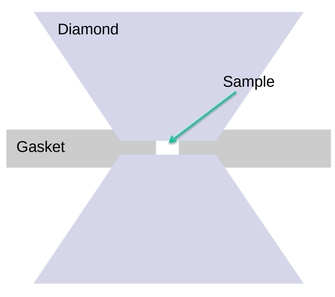

Fig. 1. Diagram of diamond anvil cell (DAC)

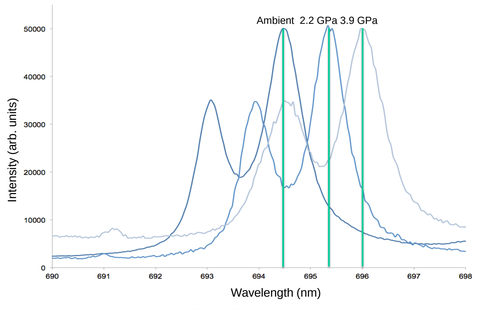

Fig. 2. Ruby Fluorescence Spectra

Fourier Transform Infrared Spectrometer

An interferogram of the sample is taken while it is under vacuum.

A Fourier transform is preformed on the raw data to obtain the transmission spectrum.

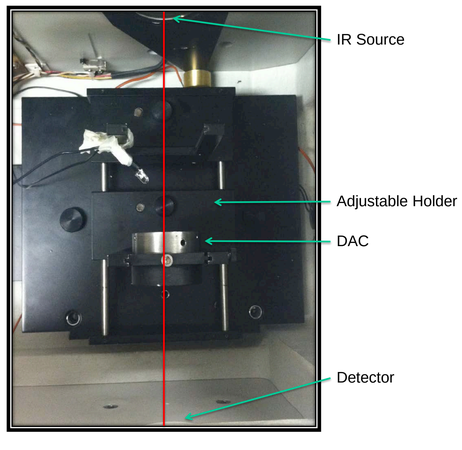

Fig. 3. Setup in FTIR vacuum chamber

Results

Mineral Oil and Pressure

Two major absorption peaks from mineral oil were observed in the frequency range of 4250-4450 cm^{-1}.

These mineral oil absorption peaks were found to linearly increase in frequency with respect to pressure.

Fig. 4. Transmission spectra of mineral oil under various pressures.

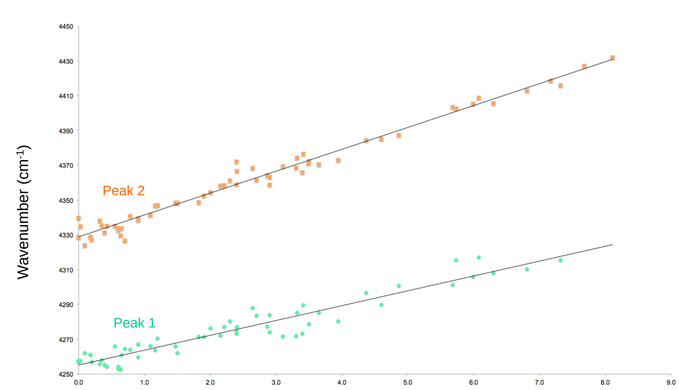

Fig. 5. Mineral oil absorption peak wavenumbers versus pressure

Selenium Dioxide

Changes in the selenium dioxide sample may have occurred due to exposure to the FTIR vacuum chamber, affecting the color of the selenium dioxide and the IR transmission.

The sample remained colorless under vacuum, but turned orange when re-exposed to air. Its shade was darker the longer it spent under vacuum.

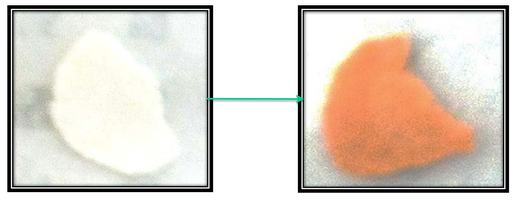

Fig. 6. Selenium dioxide pellets. Left image shows sample before being placed in FTIR vacuum chamber. Right image is of sample after 2 days in FTIR vacuum chamber.

Additionally, the red selenium dioxide transformed back to its original white color when pressure was applied to it.

Conclusion

Due to the relationship between its absorption peaks and pressure, FTIR of mineral oil can potentially be used for as a method of pressure calibration.

Further research should seek to determine the physical properties of selenium dioxide under vacuum and high pressures.

This work was supported by the DOE/NNSA Grant No. DE-NA0002007