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RUE program
Midsummer report

The cooling effect on Earth by nitrate and sulfate particles in the atmosphere.

During my summer research project under the direction of Prof. Scot Martin and supervised by Julie Schlenker I have been working on growing crystals formed by different compositions of ammonium, nitrate and sulfate and analyzing them with infrared spectroscopy. In doing this we are able to get more information about the state of those particles in the atmosphere and how much they contribute to the cooling effect on Earth by scattering sun radiation.

My specific scientific goal in this summer project is to grow the three double salt crystals, ammonium nitrate•ammonium bisulfate, 3ammonium nitrate•ammonium sulfate, 2ammonium nitrate•ammonium sulfate, as well as ammonium nitrate and their infrared absorbance. The infrared spectra of the first 3 crystals have not been reported yet, so this goal is directed to get the accurate spectra of those crystals, which will serve as reference spectra to compare other people studies about the same topic.

A small amount of a solution with the composition of the target crystal was placed in the bottom of a beaker. The beakers with the four different solutions were stored in a closed desecator at cold temperature. Since the ammonium nitrate is highly volatile, we controlled the concentration of gaseous ammonium nitrate inside the desecator by placing pure ammonium nitrate crystals on a separate beaker. This pure ammonium nitrate will evaporate in a faster rate than the ammonium nitrate in the solutions; the equilibrium inside the desecator will reduce the probability of evaporation of the ammonium nitrate in our solutions before crystallization occurs.

After 9 days the crystals were ready; we started collecting their infrared spectra using the Diffuse Reflectance infrared spectroscopy (DRIFTS) technique. The DRIFTS technique is most often used to analyze powders where the radiation is reflected at the sample surface, absorbed, scattered and transmitted through the sample. The diffusely reflected light is collected by the accessory optics and directed onto the spectrometer

detector, producing the IR spectrum. A Nexus Nicolet 670 FTIR is used to record the DRIFTS spectra from 500-7400 cm^{-1} with 2 cm^{-1} resolution. Usually 100 scans were recorded.

During the sample preparation, a small amount of the crystals were ground and mixed with a non-absorbing matrix (KBr in this experiment). In view of the fact that the ammonium nitrate is highly volatile special care must be taken before recording the DRIFTS spectra such as preparing the sample as fast as possible in a dry air room.

Usually these kinds of spectra are reported either in the transmission equivalent or the absorbance equivalent. Thus, to be able to compare my results with other works related, a Kubelka-Munk conversion is applied to the diffuse reflectance spectrum.

To date, I have been able to collect the spectra of 2ammonium nitrate• ammonium sulfate and 3mmonium nitrate• ammonium sulfate crystals.

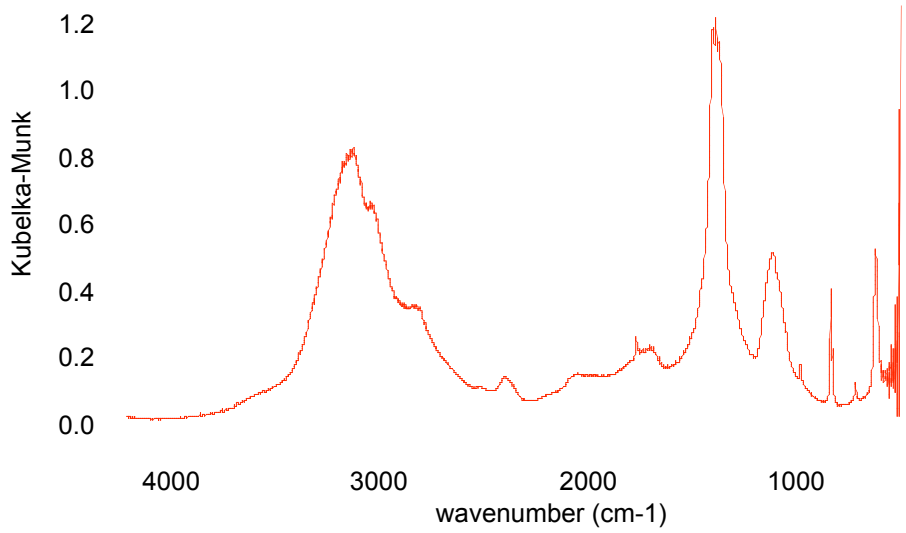

FIGURE 1: 2ammonium nitrate•ammonium sulfate spectra

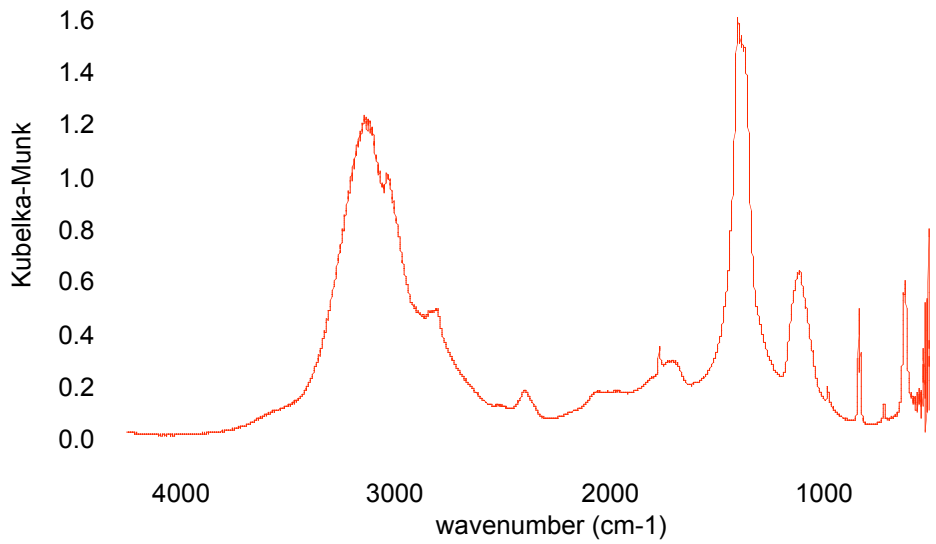

FIGURE 2: 3ammonium nitrate• ammonium sulfate spectra

After collecting all the data, I will be working on the analysis and comparison of the signals in each spectrum.