NEAR-INFRARED SPECTRA OF UV-PHOTOLYZED LABORATORY ANALOGS OF PLANETARY ICES. P. A. Gerakines[1] and C. R. Richey[1], [1]Department of Physics, University of Alabama at Birmingham, CH 310, 1530 3rd Ave S, Birmingham, AL 35294-1170, gerak@uab.edu.

In this abstract we describe the development of laboratory techniques required to create thick (10-100μm) UV-photolyzed ices. Three techniques are under study in our laboratory, including a closed-cell technique that allows UV photolysis within the cell. Preliminary results from these techniques will be discussed.

Significant chemical and physical information about icy planets and satellites can be realized from their observation at near-infrared wavelengths [1]. Work in the literature, often utilizing comparisons between the observed data and near-IR laboratory reflectance spectra of single-component unprocessed ices, has deduced the general composition of some icy surfaces [2]. These surfaces are exposed to ultraviolet and particle irradiation from various sources, and these forms of energy are thought to drive non-thermal chemistries there [3]. Therefore, the spectra of single-component, unprocessed laboratory analogs do not provide the best representations of icy surfaces in these energetic environments.

Laboratory studies using spectra of ice analogs in the mid-infrared range (λ = 2.5-25 μm) clearly indicate a complex series of chemical reactions can take place in these environments [4-6], but there is a dearth of spectroscopic analyses that have included laboratory spectra of photolyzed ices in the near-infrared range (λ = 1.0-2.5 μm). At the University of Alabama at Birmingham, we are equipped to create samples of UV photolyzed ices and obtain both their near- and mid-IR spectra. In this way, we are able to combine both techniques for maximal information.

Due to the small penetration depth of UV photons into an ice—on the order of 1 μm—thin ices have commonly been the focus of photochemical experiments. The low absorption strengths of near-IR features of molecular ices dictate that a much thicker ice is required for the identification of product features at these shorter wavelengths [7]. Therefore, the combination of UV photolysis for processing and near-IR spectrscopy for analysis is not straightforward.

To achieve significant levels of processing throughout such an ice layer, photolyzed ices must be (1) built up in stages or (2) deposited simultaneously with the photolysis. Some preliminary work on this topic has been presented earlier [8,9], and we will discuss more recent results using these two techinques.

Figures 1 and 2 display the near-IR (9000-4500 cm^{-1}, 1.1-2.2 μm) and mid-IR (4000-400 cm^{-1}, 2.5-25 μm) spectra for a pure CO_2 sample at 7 K that has been built up in stages. For this experiment, 10 layers with a thickness of 1 μm have been consecutively deposited and photolyzed. Despite the strong product absorption features in the mid-IR (Fig. 2), the near-IR features of products (Fig. 1) are absent. We have therefore shifted our focus to other techniques.

Most recently we have implemented a new technique that utilizes a closed gas cell of similar design to those used in previous ice studies [2], but modified to allow for the inclusion of UV photolysis. A schematic

Figure 1.

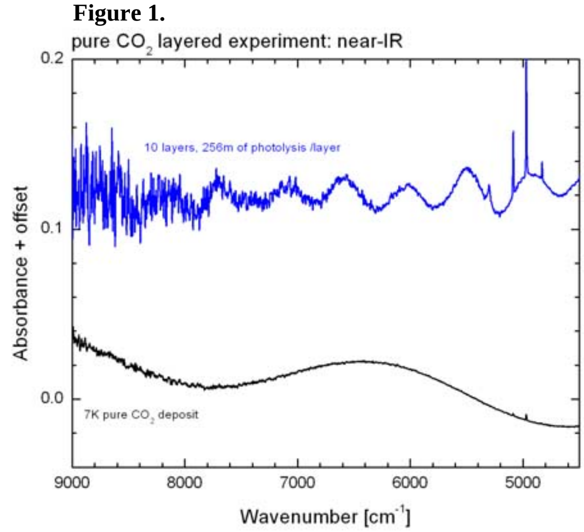
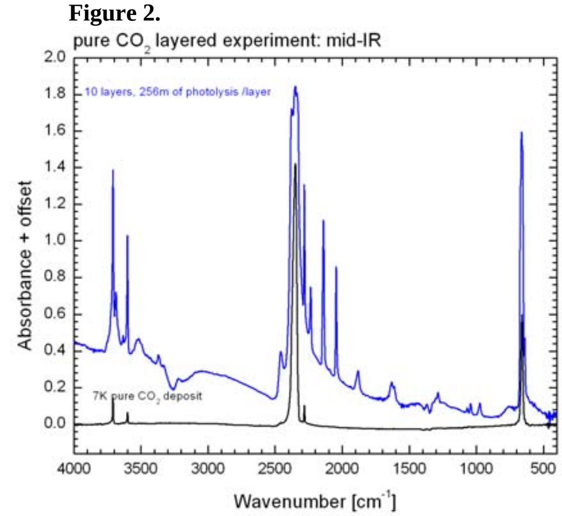


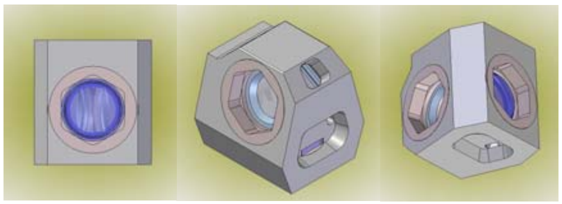
Figure 2.



of the gas cell is given in Figure 3. In summary, the cell has a triangular cross section in which two windows allow the transmission of the spectrometer's IR beam and the third allows the transmission of UV photons into the cell. Gases are allowed to condense on the IR-transparent windows but not the UV-transparent window. We will discuss the preliminary results we have obtained thus far.

The ultimate goal of our work is to provide fundamental laboratory data with which near-IR observations (e.g., from spacecraft instruments such as Galileo NIMS, Cassini VIMS, HST NICMOS, or JWST, or ground-based telescope instruments such as NIRSPEC on Keck or SpeX on the IRTF) may be compared.

Figure 3. New gas cell design.



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