

Studies of the temperature dependence of the photoabsorption spectrum of solid ammonia

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Abstract.

To date approximately 130 molecules have been identified in the interstellar medium (ISM). Several of which, are also found on comets and planetary bodies. Typical temperatures in astrophysical environments are in the range of 10 K to 150 K, and so these molecules are often found in the condensed phase. Photochemical processing of these ices is important in the formation of new molecular species within interstellar and solar system ices. In this poster we will describe recent experiments on the VUV spectroscopy of one of the most important molecules, ammonia. To date, most measurements of the vacuum ultraviolet (VUV) photoabsorption cross sections have been carried out in the gas phase using synchrotron radiation. Although this is a well established technique in the study of gas phase molecules, particularly of atmospheric species, the electronic properties of bulk ices are not well understood due to the lack of experimental and theoretical data in this area. Few VUV studies of pure astrophysical ices have been carried out and most of that existing data is of limited resolution. Therefore, presented here are the results of the photoabsorption studies performed using synchrotron radiation of condensed ammonia between 25 and 150 K; significant to astrochemical environments.

Results show that there are significant differences in the absorption properties of ammonia when in the gas phase compared to the condensed phase at 25 K. In addition the spectrum of the ices formed at 25 and 75 K is quite different; specifically three new absorption features are observed at 75 K, the most interesting occurring at 194nm. It is believed that this peak is due to the formation of an exciton within the solid. This is strong evidence for the transition of the ice from an amorphous state to a more ordered structure as the ice is heated to the higher temperature. This inference is also supported by infrared studies of the same ice. However, when the 25K system is heated to 75 K and above, this feature is not reproduced. This suggests that annealing does not produce a more ordered crystalline structure. From these studies it is quite clear that the difference between the electronic structure of the various phases of ammonia may impinge on the resulting photochemistry, and consequently on the processes that occur in the different astrophysical environments. In addition, this investigation also demonstrates that VUV studies are able to access information that other techniques such as infrared spectroscopy cannot.

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