

## Extreme Ultraviolet Photon-Induced Chemical Reactions in the C<sub>2</sub>H<sub>2</sub>-H<sub>2</sub>O Mixed Ices at 10 K

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### Abstract:

Experimental results on the spectral identification of new infrared absorption features and the changes of their absorbances produced through vacuum ultraviolet–extreme ultraviolet (VUV–EUV) photon-induced chemical reactions in the C<sub>2</sub>H<sub>2</sub>–H<sub>2</sub>O mixed ices at 10 K are obtained. To the best of our knowledge, this is the first time that EUV photons have been employed in the study of the photolysis of ice analogues. Two different compositions, i.e., C<sub>2</sub>H<sub>2</sub>:H<sub>2</sub>O=1:4 and 1:1, were investigated in this work. A tunable intense synchrotron radiation light source available at the Synchrotron Radiation Research Center, Hsinchu, Taiwan, was employed to provide the required VUV–EUV photons. In this study, the photon wavelengths selected to irradiate the icy samples corresponded to the prominent solar hydrogen, helium, and helium ion lines at 121.6 nm, 58.4 nm, and 30.4 nm, respectively. The photon dosages used were typically in the range of  $1 \times 10^{15}$  to  $2 \times 10^{17}$  photons. Molecular species produced and identified in the ice samples at 10 K resulting from VUV–EUV photon irradiation are mainly CO, CO<sub>2</sub>, CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, CH<sub>3</sub>OH, and H<sub>2</sub>CO. In addition to several unidentified features, we have tentatively assigned several absorption features to HCO, C<sub>3</sub>H<sub>8</sub>, and C<sub>2</sub>H<sub>5</sub>OH. While new molecular species were formed, the original reactants, i.e., H<sub>2</sub>O and C<sub>2</sub>H<sub>2</sub>, were detectably depleted due to their conversion to other species. The new chemical species produced by irradiation of photons at 30.4 nm and 58.4 nm can be different from those produced by the 121.6-nm photolysis. In general, the product column density of CO reaches saturation at a lower photon dosage than that of CO<sub>2</sub>. Furthermore, the production yield of CO is higher than that of CO<sub>2</sub> in the photon irradiation. In the present study, we also observe that the photon-induced chemical reaction yields are high using photons at 30.4 and 58.4 nm. The results presented in this work are essential to our understanding of chemical synthesis in ice analogues, e.g., the cometary-type ices and icy satellites of planetary systems. © 2002 Elsevier Science (USA).