Photo-desorption of circumstellar nitrogen-bearing ice analogs

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We study the photo-desorption occurring in H_2O:CO:NH_3 ice mixtures irradiated with monochromatic (550 and 900 eV) and broad band (250-1250 eV) soft X-rays generated at the National Synchrotron Radiation Research Center (NSRRC, Hsinchu, Taiwan). We detect many masses photo-desorbing, from atomic hydrogen (*m/z* = 1) to complex species with *m/z* = 69 (e.g., C_3H_3NO, C_4H_5O, C_4H_7N), supporting the enrichment of the gas phase.

At low number of absorbed photons, substrate-mediated exciton-promoted desorption dominates the photo-desorption yield inducing the release of weakly bound (to the surface of the ice) species; as the number of weakly bound species declines, the photo-desorption yield decrease about one order of magnitude, until porosity effects, reducing the surface/volume ratio, produce a further drop of the yield.

We derive an upper limit to the CO photo-desorption yield, that in our experiments varies from 1.4 to 0.007 molecule photons^{-1} in the range _ 10^{15}-10^{20} absorbed photons cm^{-2} . We apply these findings to a protoplanetary disk model irradiated by a central T Tauri star.