The Photochemistry of Pyrimidine in Pure H_2O Ice Subjected to Different Radiation Environments and the Formation of Uracil

M. Nuevo[1,2,*], Y.-J. Chen[3,4], C. K. Materese[1,2], W.-J. Hu[4], J.-M. Qiu[4], S.-R. Wu[4], H.-S. Fung[5], S. A. Sandford[1], C.-C. Chu[4], T.-S. Yih[4], C.-Y. R. Wu[3], and W.-H. Ip[6]
[1]*NASA Ames Research Center, Moffett Field, USA*
[2]*SETI Institute, Mountain View, USA*
[3]*Space Sciences Center and Department of Physics and Astronomy, University of Southern California, Los Angeles, USA*
[4]*Department of Physics, National Central University, Zhongli, Taiwan*
[5]*National Synchrotron Radiation Research Center, Hsinchu, Taiwan*
[6]*Graduate Institute of Astronomy, National Central University, Zhongli, Taiwan*
**e-mail: michel.nuevo-1@nasa.gov*

Nucleobases are *N*-heterocycles which are the informational subunits of DNA and RNA. They include pyrimidine bases (uracil, cytosine, and thymine) and purine bases (adenine and guanine). Nucleobases have been detected in several meteorites **[1–4]**, although no *N*-heterocycles have been observed in space to date **[5,6]**. Laboratory experiments showed that the ultraviolet (UV) irradiation of pyrimidine in pure H_2O ice at low temperature (≤20 K) leads to the formation of pyrimidine derivatives including the nucleobase uracil and its precursor 4(3*H*)-pyrimidone **[7]**. These results were confirmed by quantum chemical calculations **[8]**. When pyrimidine is mixed with combinations of H_2O, NH_3, CH_3OH, and CH_4 ices under similar conditions, uracil and cytosine are formed **[9]**. In the present work we study the formation of 4(3*H*)-pyrimidone and uracil from the irradiation of pyrimidine in H_2O ice with high-energy UV photons (Lyman α, He I, and He II lines) provided by a synchrotron source. The photo-destruction of pyrimidine in these H_2O ices as well as the formation yields for 4(3*H*)-pyrimidone and uracil are compared with our previous results in order to study the photo-stability of pyrimidine and the production efficiency of uracil as a function of the photon energy.

References

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