THE SOFT X-RAY INDUCED CHEMISTRY OF CO AND CH3OH IN WATER ICE STUDIED BY NEXAFS

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The irradiation of organic molecules in condensed water is an important process in a wide variety of scientific areas, from the chemistry of the interstellar space medium[1] to radiobiology.[2] Aiming at characterizing these reactions at a molecular scale, we have recently developed the use of the Near-Edge X-ray Absorption Spectroscopy (NEXAFS) for studying irradiation of icy solutions. In this work, the soft X-ray induced chemistry of H_2O, CO and CH_3OH and the effects of the water and nitric acid hydrate ($HNO_3.1.65H_2O$) matrix on the photochemistry of CO and CH_3OH have been investigated. For pure H_2O, CO and CH_3OH ices, the destruction rates are strongly limited by back reactions, leading to strikingly high survival rates of these molecules upon the harsh irradiation conditions to which they were submitted. We also evidence the interplay between the photochemical reactions of CO and CH_3OH and those of the matrix. The OH and O radicals released by the photolysis of H_2O and HNO_3 react with the CO and CH_3OH and their fragments, considerably reducing the survival rates, especially in presence of nitric acid, and dramatically enhancing the formation of CO_2 at the expense of CO. Because NEXAFS spectroscopy allows identifying which reactions are important among those possible, it emerges a simple picture of the photochemical routes of CO and CH_3OH in the H_2O and HNO_3/H_2O environments.

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[2] K. Fujii, N. Shikazono and A. Yokoya, J. Phys. Chem. B, **113**, 16007 (2009).