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Desorption of neutrals, cations and anions induced by core-excitation of water ice

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Water ice plays an important role in many different fields of physical sciences. In particular, water ice is ubiquitous in the interstellar medium. Interaction between condensed water and high energy radiation –such as X-ray photons –is a key process in space, that plays an important role in the balance between the gas phase and the solid phase. The core excitation of water ice has been the subject of many investigations. For example, the desorption of the H^+ ion has brought information on the relaxation processes (Auger decay into various states or ultrafast dissociation) that follow the absorption of a photon. However, desorption of other positive ions or negative ions has to our knowledge not been studied so far, and little is known on the desorption of neutral species.

We studied X-ray induced desorption from water ice in the O 1s range (520 –600 eV) using monochromatized synchrotron radiation from the SOLEIL facility. The approach combines neutral and ion quantitative detection as a function of photon energy, and kinetic energy filtering of the ionic species. Neutral species are found to be by far the most abundant species desorbed, and the desorption process is probably dominated by secondary electrons. Cations other than H^+ have a desorption yield orders of magnitude lower than H^+, but are nonetheless detected. The spectral signature of fragments such as O^+ or OH^+ deviate from the absorption spectrum of the ice and show that they are majorly produced through core excitation of photoproduced molecules in the ice such as H_2O_2. We have detected for the first time desorption of anions, H^-, O^- and OH^-. Once again, their desorption spectral signatures deviate from the absorption, showing desorption is not dominated by mechanisms associated with secondary electrons (such as DEA), although they do contribute in part to anion production.

Summary

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