

RADIOLYSIS OF DIFFERENT ALLOTROPIC WATER ICES

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Sinopse. In this work, we simulated the cosmic ray effects in water ice using ²⁵²Cf Fission Fragments with medium energy around 65 MeV. The measurements have been performed inside a high vacuum chamber at Van de Graaff ion accelerator located at PUC-Rio, Rio de Janeiro, Brazil. In this way, it was possible to study the ion desorption due to radiolysis in ices constituted by water at different temperatures (from 30 up 140 K), to investigate the different allotropic water ices.

In several environments, such as protoplanetary disks, molecular clouds and icy bodies in our planetary system, the ices are an important reservoir of more complex molecular species, which contain information about the composition and can provide details of formation of our solar system. Water ice is the dominant constituent of interstellar ices in most lines of sight and is about 70 % of the composition in comets, being a key molecule in astrochemical models. It is believed that one of the reactive species possibly evaporated from the water ices is the hydronium ion, H₃O⁺, which plays an important role in the oxygen chemistry network. This ion has been detected in the lunar surface of Enceladus and Titan, and toward the Sagittarius B2 molecular Clouds where H₂O and OH were also identified.

In this work, we simulated the cosmic ray effects in water ice using ²⁵²Cf Fission Fragments with medium energy around 65 MeV. The measurements have been performed inside a high vacuum chamber at Van de Graaff ion accelerator located at PUC-Rio, Rio de Janeiro, Brazil. In this way, it was possible to study the ion desorption due to radiolysis in ices constituted by water at different temperatures (from 30 up 140 K), to investigate the different allotropic water ices. A discussion on the rate of H₃O⁺ and water delivered to gas phase inside dense mo-

lecular clouds considering a constant cosmic ray flux is given.

From the Time Of Flight (TOF) spectrum of the positive desorbed ions from H₂O condensed at T = 30 and 40 K (high density) it is possible to see that the main observed desorbed ions are H⁺, OH⁺, H₂O⁺, H₃O⁺ and clusters formed by (H₂O)_nR⁺, where R⁺ is H⁺ or H₃O⁺. For H₂O condensed at T = 125 K, temperature close to the sublimation (~145 K), other species arise trapped in the ice. Condensed at 30 K, the ice is formed by a high density amorphous structure, which density is ~1,1 g/cm³. At 70 K, the ice is yet amorphous, but its density is lower, ~ 0,94 g/cm³. To these two different temperatures have the same (amorphous) phase and their yields are close. Therefore, the yield distribution of the high density ice (30 K) is different than those of low density ice (125 K). Since the cluster distribution changes according to the ice structure, we propose that the yield distribution shape could be used as a fingerprint of the ice density.

To n > 14, the yields are approximately the same for all ice structures showing that for large clusters - which are formed in a region away from the impact - the yield is not very sensitive to the sample temperature.

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