Photochemistry of Sulfur-species in ice mantles

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Sulfur chemistry is a trending topic in Astrochemistry. Several S-species are commonly detected in the gas toward interstellar and circumstellar environments, such as SO_2, SO, CS, OCS, H_2S, C_2S and H_2CS, but their total observed abundance in the dense interstellar medium is more than one order of magnitude lower than the sulfur cosmic abundance. Refractory sulfur in dust grains is summoned to account for the S-depletion in dense clouds and protoplanetary disks. This refractory form of sulfur, however, remains a mistery. Laboratory experiments involving irradiation of H_2S in the ice, theoretical models, and the detection of S_2, S_3 and S_4 in comet 67P during the Rosetta mission, suggest that S-chains is a potential source of refractory sulfur in the dust.

Figure 1 displays the thermal desorption of an irradiated H_2S ice sample [1]. Each mass over charge (*m/z*) value corresponds to the molecular ion of a species or to a fragment of a larger species. The desorption temperatures of S_x molecules are indicated by the solid vertical lines, while dashed lines indicate the desorption of H_2S_x species. Apart from the molecular ion of each species, the *m/z* values of the main fragments used to confirm the presence of these species are displayed.

A brief overview of experiments mimicking the photochemistry of H_2S and other S-bearing species in the ice will be presented. We use the experimental data and modeling to interpret the observational results. The study of S-species in the ice serves to prepare the observations of refractory sulfur and to interpret the gas phase observations accounting for the desorption of S from the ice. In addition to thermal desorption when the dust temperature is high enough, other mechanisms were proposed for the release of solid S-species to the gas phase, among them are chemical desorption [2] and photodesorption [3] . The latter mechanism will also be discussed in our presentation.

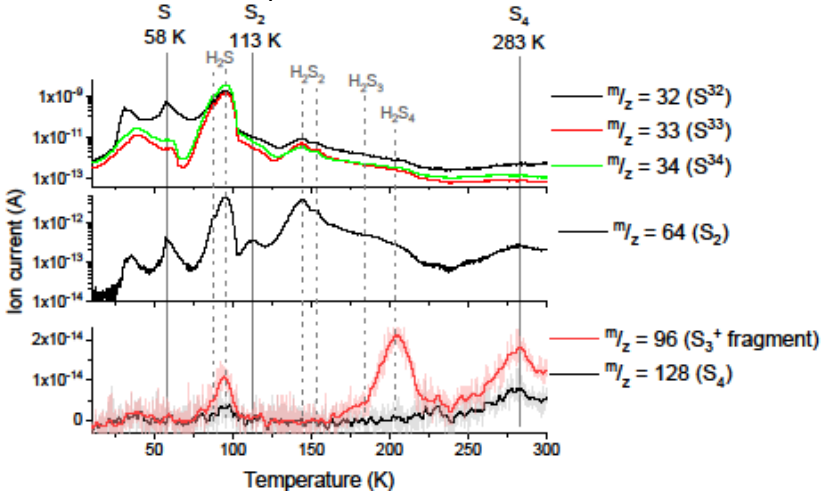

Figure 1: Desorption of S-photoproducts during warm-up of a previously UV-irradiated H_2S ice layer, adapted from [1].

References

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