Temperature Programmed Desorption of SO_2 from Water Ice Surfaces: Adsorption Energy Distributions

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Sulfur-bearing species play a key role in the chemical evolution of the interstellar medium and icy bodies in the Solar System, such as the surface of Jovian moons. Yet the sulfur budget remains poorly constrained. Sulfur dioxide (SO_2) is considered one of the main sulfur reservoirs in icy environments, making its interaction with water ice surfaces highly relevant for the understanding and modelling of the S-based astrochemistry [1].

We performed experiments to extract adsorption energy distributions of SO_2 on water ice substrates as a model for astrophysical environments, in order to better constrain its thermal behavior and solid–gas exchange processes for astrochemical simulations. To achieve this, we conducted a systematic experimental study of temperature-programmed desorption (TPD) of SO_2 deposited on three types of surfaces: polycrystalline gold, compact amorphous solid water, and crystalline water ice (see Fig. 1).

Experiments were carried out under ultra-high vacuum conditions using the SPICES (Surface Processes and ICES) setup at Sorbonne Université (MONARIS). By analyzing the different desorption flux profiles, we highlight distinct desorption regimes associated with multiple implantations of the SO_2 molecule within the different solid water films [2]. In this presentation, I will demonstrate how TPD measurements reveal the complex desorption behavior of SO_2 on water ice and provide quantitative adsorption energy distributions, offering new constraints for modeling sulfur chemistry in astrophysical icy environments.

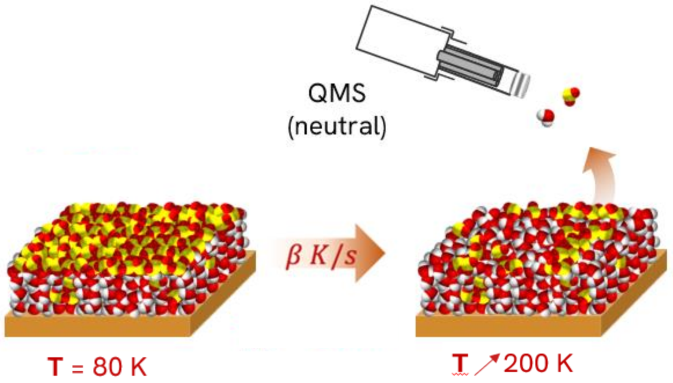

Figure 1: Concept of a TPD experiment with SO_2 (red and yellow) deposited at 80 K on compact amorphous solid H_2O (white and red) grown at 100 K on polycrystalline Au substrate. The substrate is heated with a linear temperature ramp ($\beta = 12$ K/min) up to 200 K. During heating, molecules desorb from the surface, creating a desorption flux that is detected by a quadrupole mass spectrometer.

[1] Misfud, D. V., et al. 2021, Space Science Reviews, 217, 14

[2] Benoit, F., et al, 2026, A&A in review

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