Contribution ID: **165** Type: **Poster**

Temperature programed desorption of water ice mixed with amorphous carbon and silicate grains

Thursday 14 June 2018 10:38 (1 minute)

The desorption of molecular ices from grain surfaces is important in a number of astrophysical environments including dense molecular clouds, circumstellar regions, cometary nuclei, and surfaces and atmospheres of planets. It has been shown that for multicomponent ices within water ice matrices, the desorption of all species in the ice is controlled by the behaviour of water. A study of the desorption of H_2O ice mixed with dust is therefore crucial for our understanding of the ice-dust interaction and in turn, the physics of cold dense molecular clouds and circumstellar disks, where the relatively high dust density allows coagulation of dust grains, which can be catalysed by water. Measurements of ice-dust interactions will further aid our understanding of the structure and morphology of dust aggregates at different phases of the ISM.
In our experiments, for the first time, temperature programmed desorption (TPD) of water ice *mixed with* amorphous carbon and silicate grains has been studied in the laboratory. Grain/ice mixtures represent laboratory analogues of interstellar and circumstellar icy dust grains. We show that variations of the grain/ice mass ratio lead to a transformation of the TPD curve of H_2O ice, which can be perfectly fitted with the Polanyi-Wigner equation by using fractional desorption orders. For carbon grains the desorption order of H_2O ice increases from 0.1 for pure H_2O ice to 1 for the grain/ice ratio of 1.3. For two silicate/ice mixtures, the desorption order of H_2O ice is 1. This is a unique result, which have not been obtained in previous experiments on the thermal desorption of ices *from* carbon and silicate surfaces. It can be explained by the desorption of water molecules from a large surface of fractal clusters composed of carbon or silicate grains and provides a link between the structure and morphology of dust grains and the kinetics of desorption of water ice mixed with these grains.

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Primary authors: POTAPOV, Alexey (Max Planck Institute for Astronomy); Dr JÄGER, Cornelia (University of Jena); Prof. HENNING, Thomas (Max Planck Institute for Astronomy, Heidelberg)

Presenter: POTAPOV, Alexey (Max Planck Institute for Astronomy)

Session Classification: Poster Presentations

Track Classification: What is dust?