

4.053 Interaction of acidic trace gases with ice: XPS and NEXAFS analysis with the new NAPP chamber for solid interfaces at SLS.

Early Career Scientist

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Abstract:

Acidic trace gases, such as HCl and formic acid, play an important role in atmospheric chemistry. The presence of ice disturbs this chemistry. The molecular processes of the interaction of acidic trace gases with ice are still a matter of debate. Neither a quantification of the uptake is possible nor a molecular picture of the uptake is available at temperatures relevant to Earth's snow cover (Bartels-Rausch et al. 2014 (Atmos. Chem. Phys.) Huthwelker et al. 2006 (Chem. Rev.)). This hinders the development of global models that would allow predicting changes to the large-scale effects of ice clouds. So far, direct experimental observations of the ice surface and of the interaction with trace gases at temperatures and concentrations relevant to the environment are limited. In this study, we take advantage of the surface and analytical sensitivity as well as chemical selectivity of photoemission and absorption spectroscopy performed at ambient to overcome this limitation in environmental science. The usage of X-ray Photoelectron Spectroscopy (XPS) allows us to get the concentration depth profile of dopants. To perform measurements close to atmospheric conditions the Near-Ambient-Pressure-Photospectroscopy endstation (NAPP) chamber at SLS was optimized (Orlando et al. 2016 (Topics in Catalysis)). With the combination of XPS and Near-Edge X-ray Absorption Finestructure (NEXAFS) we get information whether the interaction with the trace gas leads to enhanced surface disorder of the ice surface and to what extent this change influences the uptake of the trace gas.

Here we present the first analysis of the interaction and uptake of HCOOH with ice by means of electron spectroscopy. Depth profiles indicate that the dosed acid stays at the ice surface as long as disorder is not enhanced. The results are compared to earlier

analysis using different approaches and trace gases.