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Liquid like layer studied with NEXAFS

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As temperature approaches the melting point of ice, the hydrogen bonding network at the air – ice interface evolves from a well-structured arrangement towards more randomly spatialized interactions. There is a general agreement on this Liquid-Like Layer (LLL) or Quasi-Liquid-Layer (QLL) existing at the surface of ice. Reports on the thickness of this disordered interfacial layer range from 2 nm to 25 nm at 271 K, depending on the probing technique (atomic force microscopy (AFM), ellipsometry, optical reflectivity, sum frequency generation (SFG)). Nevertheless, all studies report that the thickness increase with temperature [1]

We investigate this LLL using Near Edge X-ray Absorption Fine Structure (NEXAFS) [2] to help resolve the discrepancy of current thickness data. The importance of the LLL's thickness comes from its contribution to environmental science as reservoir for chemical impurities and as host of chemical reactions with impact on atmospheric and cryospheric composition. In this study, we probe Auger electrons emitted upon X-ray absorption, thus, NEXAFS becomes inherently sensitive to the air-ice interfacial region of a few nm thickness.

We will present a first data set of NEXAFS from neat ice between – 3 °C and – 20°C acquired at the NAPP endstation at the Swiss Light Source of the Paul Scherrer Institute. Preliminary analysis indicates that the LLL is very much limited to the upper layers of the ice crystal within the air-ice interface. Results will be compared to earlier studies. The preliminary results suggest that the interfacial disorder seems to be less pronounced than reported in many earlier studies, very much in agreement to recent AFM and SFG data [3] [4].

Literature References:
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