

## O 45: Mini-Symposium: Molecular scale investigations of liquid-vapor interfaces I

Time: Tuesday 13:30–15:30

Location: R3

**Invited Talk**

O 45.1 Tue 13:30 R3

**A Superficial Look At Water** — ●OLLE BJÖRNEHOLM — Department of Physics and Astronomy, Uppsala University, Uppsala, Sweden

Water is of key importance for life itself and in numerous environmental and technical processes. Despite its importance and its simple molecular structure, the behavior of liquid water remains enigmatic. Molecules at interfaces have different environments compared to those in bulk water, resulting in various interface-specific phenomena. These are highly challenging to investigate, and our understanding of the water interfaces is therefore in many respects even more incomplete than for bulk water. In addition to their fundamental importance, water interfaces are also crucial in e.g. environmental sciences, biology and technology. In this talk, I will present some results on aqueous solutions obtained by x-ray photoelectron spectroscopy. I will exemplify how the aqueous surface differs from the bulk, including both fundamental properties, and examples relevant to atmospheric sciences.

O 45.2 Tue 14:00 R3

**A Flow-Focused Droplet Train for Investigating Liquid Phase Processes with Ambient Pressure XPS** — ●PIP CLARK, MICHAEL SEAR, MARCO FAVARO, ROEL VAN DE KROL, and DAVID STARR — Institute for Solar Fuels Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, D-14109 Berlin, Germany

Here we present a newly commissioned droplet train designed for measuring the chemical and physical properties of liquids in pressures up to 30 mbar using ambient pressure XPS. Our droplet train generates thousands of uniform droplets a second, tunable in diameter between 100 to 500 microns.

We present results from commissioning experiments on aqueous solutions and colloidal systems, and describe the advantages of using flow focusing. We also discuss the capability of time-resolved XPS using the droplet train. By changing the height of the droplet generation point above the spectroscopic analysis position and introducing a suitable time-zero trigger, different delay times can be measured. Depending on the speed of the droplets chosen, we can access delay times between tens of  $\mu$ s and hundreds of ms. Examples of possible systems to study include (but are not limited to) gas uptake at the liquid/vapor interface, photoinduced physical and chemical reactions in solution, and nucleation and growth of salt crystallites or nanoparticles.

The droplet train module is a part of the SpAnTeX end station, which focuses on AP-XPS experiments in the tender X-ray regime (AP-HAXPES). Commissioning experiments were performed at the KMC-1 beamline, at BESSY II in Berlin.

O 45.3 Tue 14:20 R3

**Chemical kinetics at the water-water interface of a liquid flat-jet** — ●HANNES CHRISTIAN SCHEWE<sup>1</sup>, BRUNO CREDIDIO<sup>2</sup>, AARON GHRIST<sup>1,3</sup>, SEBASTIAN MALERZ<sup>1</sup>, CHRISTIAN OZGA<sup>4</sup>, HENRIK HAAK<sup>1</sup>, GERARD MEIJER<sup>1</sup>, BERND WINTER<sup>1</sup>, and ANDREAS OSTERWALDER<sup>2</sup> — <sup>1</sup>Fritz-Haber-Institut der Max-Planck-Gesellschaft, Department of Molecular Physics, Faradayweg 4-6, D-14195 Berlin, Germany — <sup>2</sup>Institute for Chemical Sciences and Engineering (ISIC), Ecole Polytechnique Fédérale de Lausanne (EPFL), 1015 Lausanne, Switzerland — <sup>3</sup>Department of Chemistry, University of Southern California, Los Angeles, CA 90089-0482, USA — <sup>4</sup>Institut für Physik und CINSA/T, Universität Kassel, Heinrich-Plett-Strasse 40, 34132 Kassel, Germany

Two colliding cylindrical microjets from aqueous solutions are used to

produce a planar leaf-shaped flowing sheet. Using jets from two different aqueous solutions, each containing a reactant for a fast chemiluminescence reaction, we image the emitted photons to spatially visualize the mixing of the solutions at any position of the leaf. Diffusion across the planar liquid-liquid interface leads to mixing of chemical species from the two solutions, allowing for chemical reactions and their detection. Such a micrometer-thin flowing two solution structure offers novel opportunities for spectroscopic and kinetic studies at liquid-liquid interfaces. We present a quantitative model that describes diffusion-limited reaction kinetics at the liquid-liquid interface, which can also be extended to account for interactions at the liquid-vapour interface.

**Invited Talk**

O 45.4 Tue 14:40 R3

**Exploring Collisions and Reactions at the Vacuum-Water Interface using Water Microjets** — ●GILBERT NATHANSON — Department of Chemistry, University of Wisconsin, Madison, Wisconsin, USA

Gas-liquid scattering experiments provide molecular insights into collisions and reactions at the vacuum-liquid interface while minimizing interference from collisions in the vapor. Studies of liquid water in vacuum are especially challenging because of water's high vapor pressure. This tutorial will describe collisions of inert, organic, and atmospheric gases with a water microjet, a fast-flowing liquid stream no thicker than a strand of hair. The small surface area of the jet generates a thin vapor cloud that can be readily traversed by incoming and outgoing gas molecules with almost no gas-vapor collisions. Many other liquids can form microjets as well, including gasoline and jet fuel. I will illustrate the utility of these microjets by surveying experiments measuring the entry and longtime uptake of organic acids and bases into salty water and reactions of the atmospherically important gas N<sub>2</sub>O<sub>5</sub> in water containing both salts and surfactants. These experiments help to unravel the mechanisms by which collisions lead to scattering, trapping, solvation, and interfacial acid-base and oxidation-reduction reactions.

O 45.5 Tue 15:10 R3

**Imaging Gas-Liquid Scattering Processes in Real Space** — ●MAKSYMILIAN ROMAN, ROBERT BIANCHINI, ADAM KNIGHT, DANIEL MOON, KENNETH MCKENDRICK, and MATTHEW COSTEN — Heriot-Watt University, Edinburgh, EH14 4AS, United Kingdom

A novel technique for studying the dynamics of gas-liquid scattering was used to image the products of hydroxyl radical (OH) collisions with low-vapour-pressure liquids. A pulsed molecular beam of OH was aimed at layers of squalane, squalene and perfluoropolyether and probed by exciting laser-induced fluorescence (LIF) with pulsed laser light shaped into a sheet. The LIF signal emitted from pre- and post-collision packets of OH was intensified and captured by a camera. The images showed that OH scattered with broad angular distributions, but with superthermal speeds and rotational distributions, suggesting a predominantly impulsive mode of scattering from an atomically rough surface. The experiment has been recently modified to include a physically narrower ingoing packet of radicals and a better shaped laser probe sheet. Together with a custom-made Monte Carlo simulation of the scattering process, these are expected to provide even greater insight into the angular and speed distributions of the scattered products and hence the underlying scattering dynamics.