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Investigation of structure and dynamics of liquid surfaces by X-ray pump –optical probe measurements

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Structural and dynamical properties of surfaces and interfaces are of pivotal importance for the elucidation of surface phenomena. For example, chemical reactions at surfaces and interfaces are influenced by these properties. Here, we perform optical pump –X-ray probe measurements from liquid-air interface using LISA diffractometer [1], for the first time, installed at P08 beamline at the PETRA III synchrotron radiation source in Hamburg. The diffractometer is specialized for hard X-ray scattering studies of liquid surfaces and interfaces with highly focused X-ray beam. The setup takes advantage of the specific design of LISA, where all scattering studies can be performed without moving the sample.

Here, we also describe the extension of this instrument's capabilities by an optical pump - X-ray probe option, which will allow investigations of ultrafast processes at liquid interfaces. This includes installation of a synchronized femtosecond-laser system and optics for directing the laser pulse onto the sample surface. First results from pump-probe X-ray reflectivity experiments at the liquid - air interface has confirmed a time resolution better than 100ps. These new capabilities provide access to structural changes induced via optical excitation, allowing us to understand the non-equilibrium processes on liquid interfaces such as water and mercury. First obtained results on these systems, specifically, from liquid mercury-air interface and air-water interface will be presented here.

References

[1] B. M. Murphy, B Runge and O. M. Magnussen et al., J. Synchrotron Rad. 21, 45 (2014)

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