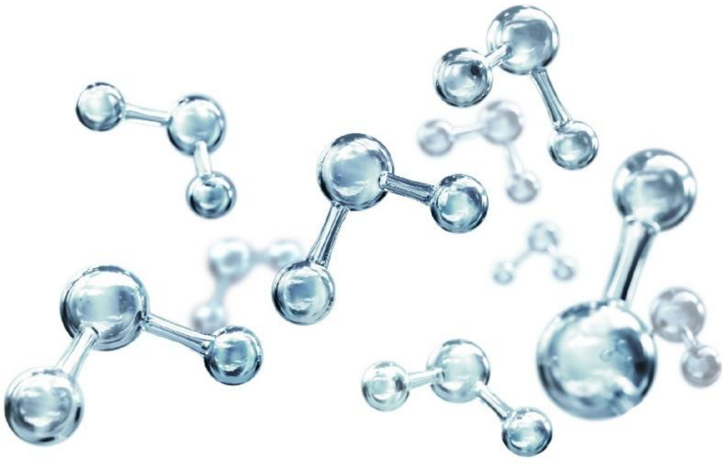
Seminar

CMWS Centre for Molecular Water Science

23rd of April 2026
12:00 h

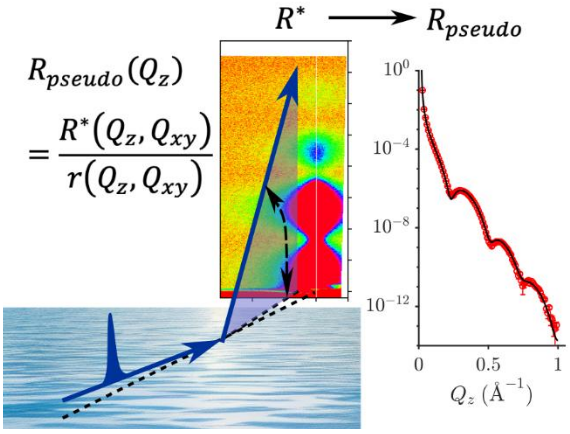
Zoom Virtual Meeting:
https://tuhh.zoom.us/j/82631283465
Meeting-ID: 826 3128 3465
Password: 978444



Chen Shen

Deutsches Elektronen-Synchrotron DESY

Grazing incidence diffuse scattering from liquid surfaces: faster and better than reflectometry?



The surface of water is important not only because of its subtle properties, but also for serving as substrates and reaction platforms in many applications, ranging from cellular membranes, lipid-based pharmaceutics to synthesis of 2D COF/MOFs. The Langmuir GID setup at the beamline P08 at PETRA III is dedicated to water surfaces and Langmuir layers, providing grazing incidence X-ray scattering (GIXS) data up to 2.5/Å in both Q_{xy} and Q_z within half minute. The remaining challenge had been complementarily acquiring the layer structures, that was conventionally measured by reflectometry (XR). The latter requires a complex optics to deflect the synchrotron beam to vary incidence onto liquid surfaces, creating high background and compromises the GIXS data quality.

A so-called pseudoreflectivity method has been developed jointly on the Langmuir GID setup and at 12ID at NSLS-II to overcome this challenge [1,2]. It allows one to acquire a reflectivity down to 10^{-14} from liquid surfaces in one single GIXS exposure, hence eliminates the demand of varying incidence for layer structure acquisition. It is based on the extended capillary wave model (eCWM). The theory provides a single analytical expression to describe both the specular reflection and the diffuse scattering around it. The single expression both implies that reflectivity can be analytically derived from diffuse scattering signal measured via GIXS. Moreover, the eCWM analysis provides the bending modulus of a film on the liquid surfaces, that is not accessible by conventional XR. Hence the GIXS-pseudoreflectivity method is faster, requires simpler instrument, and provides more information compared to the reflectometry. We have experimentally proven that pseudoreflectivity agrees with the reflectivity measured from conventional XR and can be applied to varies types of liquid surfaces, including water surfaces and surfactant layers on water.

[1] https://doi.org/10.1107/s1600576724002887

[2] https://doi.org/10.1103/znt1-fmx6