Dynamics of Liquids at Surfaces and Interfaces

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Many liquids exhibit pronounced density anomalies at surfaces and interfaces. One example are exponentially decaying layering effects (stratified liquid sheets parallel to the surface/interface), which are found at liquid metal surfaces and in ionic liquids at buried interfaces. In these cases no deviations from the average bulk density have been found in the direction normal to the surface. The origin and the nature of these surface/interface structures as well as their dynamics is not well understood.

In addition to the acoustic-like excitations, surface capillary waves are thermally exited at free surfaces. While the dispersion relation for capillary waves is well established in the hydrodynamic regime, the dynamics on the microscopic length scale is unknown.

Only recently it has become possible to perform inelastic x-ray scattering experiments in surface sensitive scattering geometry, giving access to the high frequency dynamics in the near surface region. So far, only materials composed of heavy elements could be investigated in two exemplary studies, NbSe2 (solid) [1] and In (liquid) [2]. Using liquid Indium as an example, current limitations of the technique will be discussed as well as the scientific potential.

References

[1] - B. M. Murphy et al., Phys. Rev. Lett. 95, 256104 (2005).
[2] - H. Reichert et al., Phys. Rev. Lett. 98, 096104 (2007).