LiXEdrom: Innovative measuring chamber for X-ray study of liquid jets

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X-rays are the medium of choice for many scientific studies. When you shine them on a sample, they literally shed light on the material's structure, providing loads of information about it. Unfortunately, this mostly applies to solids only, since the sample has to be in a vacuum for the entire time it is being irradiated with soft X-rays. For liquids, that means you have to remove all the water. In the case of biological samples such as proteins, however, this destroys their natural environment. The solution to this problems has always been to measure liquids through membranes. These membranes keep the evacuated side separate from the non-evacuated side. The trouble is, one can never really be sure whether or not membrane effects are distorting the measurement results.

At Helmholtz-Zentrum Berlin (HZB), Emad Aziz, head of a junior research group, has shown that liquids can be investigated by X-ray emission spectroscopy without using membranes after all. At the synchrotron source BESSY II, the group has built a special setup - the LiXEdrom. It is unique in that the liquid is shot as a jet through the X-ray beam. The jet from the nozzle becomes so thin and, at 80 metres per second, so fast that the vacuum can be maintained without the need of a membrane.

"On our LiXEdrom, we create a vacuum in the liquid chamber of up to 10^{-6} millibar, and can now perform both absorption and emission measurements, giving us even more precise information about the structure of a material," says Emad Aziz. It also allows a clear "view" of

elements that possess absorption and emission energies similar to the energies of the membrane materials, and would therefore overlap with the membrane in the spectrum when measured. This concerns above all carbon and nitrogen - precisely those elements of interest in biological samples.

In their first measurements, published in Chemical Physics and selected for the cover, the group demonstrated they can achieve energy resolutions on their LiXEdrom comparable to those of the latest high resolution XES spectrometers. For water, they have proven that results obtained from an earlier setup were not overlapped by disturbing membrane effects. They have also studied the electronic structure of nickel ions, unhampered by a risk of deposits on a membrane wall distorting the results. For many applications such as protein studies, this is a significant step towards obtaining reliable structural information.

More information: "High Resolution X-ray Emission Spectroscopy of Water and Aqueous Ions Using the Micro-Jet Technique", K.M. Lange et al. *Chem. Phys.*, DOI:10.1016/JChemPhys.2010.08.023

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