

Sample cell for soft X-ray absorption spectrometry in liquid environments

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A new sample cell concept [1] for the analysis of liquids or solid-liquid interfaces using soft X-ray spectroscopy is presented. A complete sealing of the cell as well as its transport into vacuum via, for example, a load-lock system enables near-edge X-ray absorption fine structure experiments of biologically and chemically relevant samples without removing them from their liquid environment or any freezing. The sample cell uses pressure monitoring and active as well as passive pressure regulation systems, thereby facilitating the full control over the pressure during filling, sealing, evacuation, and measurement.

In combination with the reference-free X-ray spectrometry equipment [2] of the Physikalisch-Technische Bundesanstalt at the electron storage ring BESSY II, this cell concept allows for a quantitative experimental access to the K-shell absorption edges of the light elements Carbon, Nitrogen, Oxygen and heavier elements as well as the L-edges of the 3d transition metals and other elements. Several exemplary results to demonstrate the experimental capabilities and the performance of the cell will be presented. In particular, suspensions of hemoglobin microparticles (HbMP), which serve as oxygen carriers and might be suited to replace red blood cell concentrates in transfusion medicine, were investigated in order to detect the ratio between Fe²⁺ (oxyHb/deoxyHb) and Fe³⁺ (metHb).

[1] D. Grötzsch, C. Streeck, C. Nietzold, W. Malzer, I. Mantouvalou, A. Nutsch, P. Dietrich, W. Unger, B. Beckhoff, B. Kanngießner, *Rev. Sci. Instrum.* (2017) 88, 123112.

[2] B. Beckhoff, *J. Anal. At. Spectrom.* (2008) 23, 845 – 853.