UNIKASSEL VERSITÄT

Physikalisches Kolloquium

Thursday, 16.11.2017, 17:15, HS 100
Reception with coffee & cookies 16:45
(For university staff: please bring your own cup for sustainability reasons)

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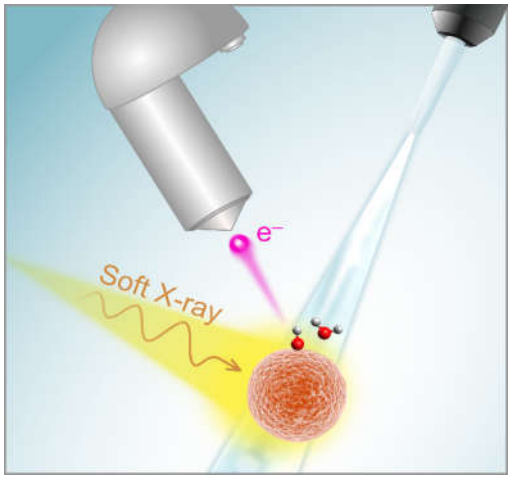
Photoemission spectroscopy from aqueous solutions

Abstract

Applications of soft-X-ray resonant and non-resonant core-level photoelectron (PE) spectroscopy to liquid microjets for the study of the electronic structure of aqueous solutions are presented. Several examples are discussed, including atomic transition-metal (TM) ions, TM-oxide nanoparticles (NPs) dissolved in water, and hydrogen-bonding molecules. Exemplified for $Fe^{2/3+}$(aq) we show that the non-radiative (autoionization) relaxation processes following resonant TM 2p excitation uniquely reveal details on the bonding interactions of the metal-aqua complexes. Our interest in the NPs is the electronic structure of the NP – aqueous solution interface, and particularly the detection of dissociated water. Results will be presented for 6-nm Fe_2O_3 NPs.

The shape of Auger-electron spectra was observed to be sensitive to the participation of solvent water in the relaxation process. For instance, the high-energy tail of the oxygen 1s Auger electron spectrum from liquid water reveals an electronic de-excitation process of core-level ionized water in which a pairs of cations form, either $H_2O^+\cdots H_2O^+$ or $OH^+\cdots H_3O^+$. [1] These reactive species are expected to play a considerable role in water radiation chemistry and biodamage. Isotope measurements show that autoionization also occurs from a series of transient Zundel-type structures evolving from proton transfer, from the ionized water molecule to a neighbor molecule, within a few femtoseconds. The actual autoionization is either through intermolecular Coulombic decay (ICD) or Auger decay.[1,2] These so-called proton-transfer mediated charge separation (PTM-CS) processes are found to also occur in other and similarly hydrogen-bonded solute molecules such as NH_3 (aq), NH_4^+ (aq), or H_2O_2 (aq).[3]

[1] S. Thürmer et al., *Nat. Chem.* ***5,*** 590-596 (2013).
[2] P. Slavicek et al., *J. Am. Chem. Soc.* **136**, 18170 18176 (2014).
[3] P. Slavicek et al., *J. Phys. Chem. Lett.* **7**, 234 243 (2016).



All of you interested in physics are cordially invited!

Contact: Dr. André Knie, Experimental Physics IV, More Information: uni-kassel.de/go/physikalisches_kolloquium