The diamond-water interface: Perspectives from advanced X-ray and infrared spectroscopies

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Abstract:
The nanoparticle-water interface play a central role in nanoparticles reactivity in aqueous environment relevant for nanomedicine, photocatalysis or environmental applications. The organization of water molecules around dispersed nanoparticles is believed to affect the colloidal stability, the interaction with cellular environment, the chemical and catalytic reactivity or the optical properties of the nanoparticles. The diamond-water interface is a key model system for interfacial phenomena in water since it is possible to tune the diamond hydrophilicity by modifying its surface chemistry. Oxidized and hydrogenated diamond bulk surfaces are often used as reference for hydrophilic and hydrophobic surfaces, respectively.

Unfortunately, the influence of aqueous environment, especially when it is related to electronic processes, cannot be investigated in liquid with classical methods. In this seminar, I will present how synchrotron-based soft x-ray absorption, emission and photoemission spectroscopies can overcome the challenge of measuring electronic structure of nanomaterials directly in aqueous environment. Using X-ray absorption spectroscopy, modification of the NDs surface chemistry induced by aqueous dispersion was recently evidenced.[1] Furthermore, a significant impact of nanodiamonds on the water organization in their solvation shell was also observed.[2] Finally, complementary characterization by Fourier Transformed Infrared Spectroscopy will be presented. Future directions implementing these methods to follow electro- and photochemical reactions at the surface of NDs and other nanomaterials in liquid environment will be discussed.

(1) Petit, T.; Pflüger, M.; Tolksdorf, D.; Xiao, J.; Aziz, E. F. Valence Holes Observed in Nanodiamonds Dispersed in Water. *Nanoscale* **2015**, *7*, 2987–2991.

(2) Petit, T.; Yuzawa, H.; Nagasaka, M.; Yamanoi, R.; Osawa, E.; Kosugi, N.; Aziz, E. F. Probing Interfacial Water on Nanodiamonds in Colloidal Dispersion. *J. Phys. Chem. Lett.* **2015**, *6*, 2909–2912.