PhD thesis at Université Paris 6

Chemical reactions in presence of a sub-nanometric surface water layer or confined water followed by NAP-XPS

At water pressure of about ten mbar, it is possible to form ultra-thin water layer (sub nm) at the solid surface like silicate, titanium dioxide, MgO or lamellar minerals (as the smectites clays or double layers hydroxides). In this ultra-thin water layer chemical reactions occur leading to surface functionalization or catalytic reactions.
The proposed work will comprise two themes where liquid water in ultra-thin layer plays a fundamental role for the reactivity. The first one is about the grafting of organosilane in presence of water at the silicon and the silicate/ silicon surfaces (used as captors of "Bio-FET"[1] type) in presence or not of an amine catalysist[2]. Other surfaces are envisaged like MgO which is used in numbered catalysis applications[3]. Due to its simple structure, the MgO(100) surface is considered as a model for the study of the water/metal oxide interface. The second theme will concern the insertion of organic molecules inside the confined water layer formed in the smectite (saponite, hectorite). This study is motivated by the recent observation of a catalytic decomposition of the pyridine at low temperature in the Sr-hectorite by our group.
The student will be formed to X-ray photoemission spectroscopy induced by synchrotron radiation. He will use the new near-ambient pressure XPS that allows to follow chemical reactions at the surface of materials in realistic conditions up to pressure of 20 mbar.

Ref:

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3. Head, A. R. & Schnadt, J. UHV and Ambient Pressure XPS: Potentials for Mg, MgO, and $Mg(OH)_2$ Surface Analysis. *JOM* **68,** 3070–3077 (2016).

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