



SEMINAIRE ISMO

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Interaction of water molecules with bare and deuterated polycrystalline diamond surface studied by high resolution electron energy loss and X-ray photoelectron spectroscopy

In this lecture we will present our studies on the interaction of water molecules with deuterated and bare polycrystalline diamond surfaces by X-ray photoelectron spectroscopy (XPS) and high resolution electron energy loss spectroscopy (HR-EELS). To distinguish the molecular origin of hydrogen bonds (i.e. C-H, O-H, C-O-H, etc.) formed on the diamond surface upon interaction with the water molecules, deuterated and hydrogenated gases were used in our experiments. Diamond films were deposited from a deuterated gas mixture to induce C(di)-D surface terminations. Water adsorption on bare diamond surface gives rise to the appearance of well defined and pronounced C-H and C-OH vibrational HR-EELS peaks and an intense O (1s) XPS peak. These chemically adsorbed water fragments survive 300°C anneal temperature under ultra-high vacuum conditions. Annealing at 600°C of the water exposed bare diamond surface results in disappearance of the C-OH vibrational modes alongside with a pronounced reduction of the C-H vibrational modes, whilst only upon annealing to ~800°C the O (1s) peak decreased substantially in intensity. We associate these effects with dissociative adsorption of the water molecules on the bare diamond surfaces.

Water exposure onto a deuterated surface, on the other hand, does not result in the appearance of the C-OH vibrational peaks but only to an increase of the C-H vibrational HR-EELS mode along side with the appearance of a weaker XPS O (1s) peak, as compared to the same experiment, performed on the bare surface. 300°C anneal significantly diminishes surface oxygen concentration, as monitored by XPS. We associate these results with H₂O decomposition reactions and with molecular adsorption on deuterated diamond surfaces. Annealing of the water exposed deuterated diamond surface, results in a pronounced decrease and disappearance of the O (1s) XPS peak at a temperature of ~800°C.

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