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The interaction of Highly Charged Ions (HCI) with surfaces mainly depends on the work function W of the target electrons as well as of the electric properties of the first layer(s) of the surfaces (metal, dielectrics…). These two main characteristics define the distance z_0 at which the ion starts extracting electrons ($z_0 \sim 1/W$), and the kinematics of the ion along the last few nm above these surfaces. Over metals the kinematics of the ions is determined by the ion image acceleration; above dielectrics by the balance between the acceleration of the ion by their electric image and the deceleration of the ions by the remnant electric charges staying on the surface during the interaction.

Most studies in the last few years of the interaction of HCI with insulators have been carried out with LiF, a dielectric allowing to get rid, by heating the targets, of the building up of static charges. We have studied the interaction of HCI with diamond surfaces. The diamond surfaces may be passivated by one atomic monolayer of hydrogen or oxygen which make respectively the surfaces conductive or insulating, or covered by graphitic layers appearing during the preparation of Diamondlike Carbon (DLC) or microcrystalline diamonds prepared by Chemical Vapor Deposition (CVD). We present in this contribution a summary of experiments carried out with the ECR sources of Grenoble and Reno on the interaction of HCI on various kinds of CVD and DLC diamond surfaces on which these conductive layers may be present or clean sputtered by the ions themselves or by exposition to an oxygen plasma.

We have studied the hollow atom X-ray spectra emitted in flight by Ar^{17+} ions approaching the considered surfaces, which we decelerated down to the energy range of 0 -12 eV/q with a precision of 1 or 2 eV/q. We have studied the changes in the interaction due to the negative electron affinity (1) of H passivated diamond surfaces, which own a small work function, giving the hollow atom more time to decay above the surface, as well as the influence of the surface conductivity which hinders the trampoline effect (2).

We also studied the changes in the X-ray spectra induced by the graphitic layers covering the surface of some DLC diamonds. It is emphasized how it may be possible with HCI to characterize and at the same time, on line, to modify the surface of the DLC or CVD diamonds by using the atomic clock property of the hollow atoms approaching or penetrating these surfaces.

References

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