FABRICATION AND SPECTRAL CHARACTERIZATION OF TAILORED NANOGRAPHENE SHEETS

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The impact of slow energy noble gas ions on metal surfaces is the origin of several physical processes, being the emission of electrons (SEE) one of the most important. The intensity and energy distribution of these electrons allow us the identification of the different mechanisms taking place during the collision. The hole-induced electron transfer (surface-ion) represents a non-adiabatic event which within a short time period of $< 10^{-13}$s creates an unoccupied state inside of an electron see. Such a transient strong localized perturbation may activate a cascade of several relaxation processes in the metal surface (electron-hole pairs, excitons, plasmons as well as the Auger de-excitation). The decay of these electronic excitations can contribute to the observed SEE when the gained energy overcomes the work-function value. Thus, the observed SEE mirrors the decay of the electronic excitations induced by slow ion impact. This fact is especially interesting for studying 2D confined systems.

The energy distributions of emitted electrons obtained for He^+ scattering on different lateral size squares patterned on HOPG surfaces (nG) have been compared to the one obtained for the reference sample: large unconfined HOPG surface [1]. The fabrication of nG was performed by FIB method recently developed in Karlsruhe [2]. Areas of cm-lateral size of the HOPG surface patterned by arrays of nG stacks were created by combining the Ga^+-FIB-based writing and the subsequently applied oxygen-based etching. The geometry of the nG arrays was monitored by means of AFM. The analysis of the SEE for the unconfined case revealed a new excitation/ deexcitation mechanism based on the autoionization of valence and excitons [1].

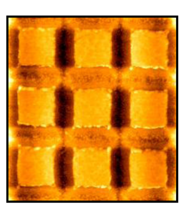

Figure 1: nG arrays

Of particular interest is the question of how the 2D size (50 nm -300 nm) could influence the Auger excitations and the lifetime of the generated excitons. The differences observed among SEE spectra coming from HOPG and nG sheets could allow us to quantify such an effect.

In this work, we present results of SEE induced by He+ at 5 keV, AFM and UPS on HOPG surfaces and (nG), in order to try to correlate the modifications of the SEE observed for nG arrays to the confinement-conditioned localization introduced by the nG sheets fabrication.

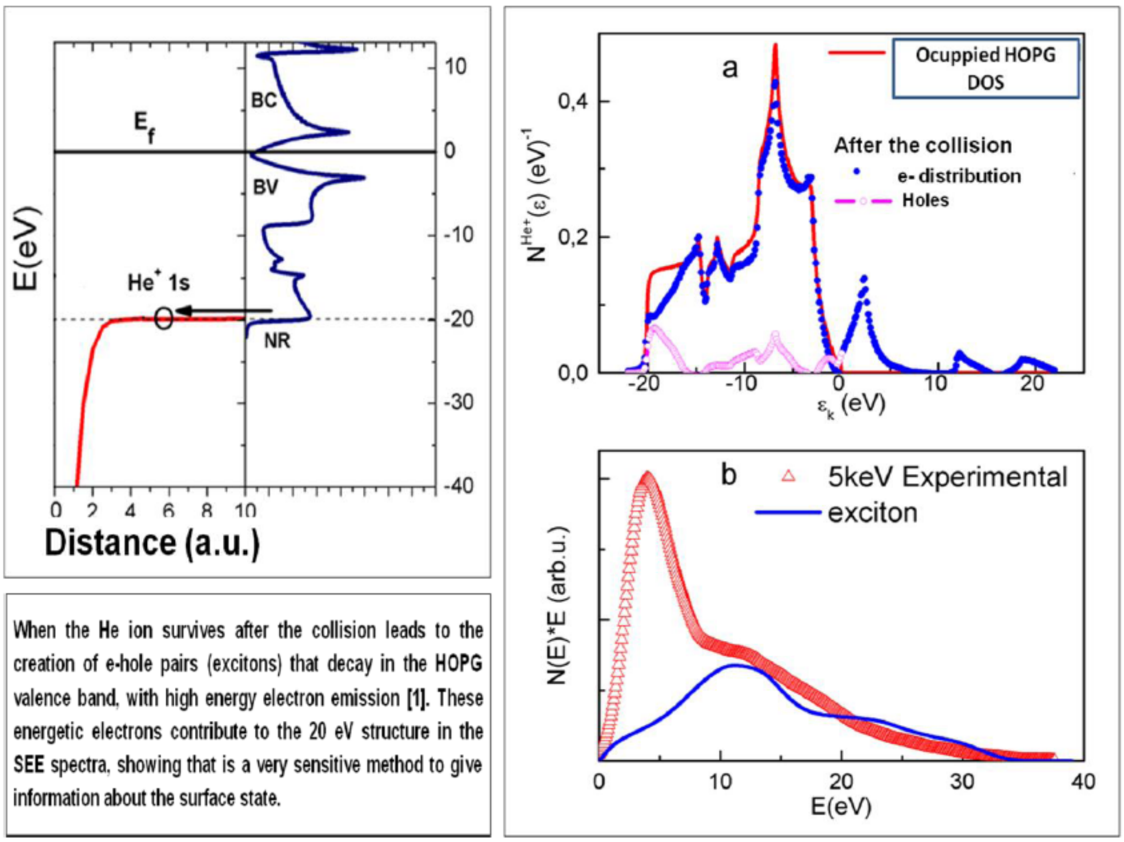

Figure 2: Mechanism of autoionization of HOPG valence exciton

References

[1] N. Bajales et al., Physical Review Letter,Vol 100, 22, (2008),227604
[2] A. Bttcher et al., Nanotechnology, 17, (2006), 5889
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