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Nanoscale NEXAFS for Probing multi-layer graphene/copper nanowires composite

Fabrication of conductive patterns on flexible substrates is a key step for the engineering of next generation of novel flexible devices. In this context, silver based inks have been the preferred one. [1] However, the high cost and electromigration effect in silver limit its applications. An attractive alternative is the use of copper nanoparticles provided that their oxidation can be avoided. [2] In this work we report on the synthesis of a graphene /copper nanowires composite based on a scaled up amine-capped and glucose-based reduction method. Graphene oxide and $CuCl_2 \cdot 2H_2O$ (the precursor), glucose (the reductant), hexadecylamine (HAD) (the capping agent), water (the solvent) were mixed and the final solution was magnetically stirred. The graphene /copper nanowires composite was collected by centrifuging the reaction solution and rinsing with deionized water.

We discuss the potential of graphene as anti-oxidation barrier to avoid an excess of oxidation of the copper nanowires. [3] Transmission electron microscopy showed the good dispersion of the metal naowires on the surface of graphene flakes. X-ray photoelectron spectroscopy was used to evaluate the interaction between the graphene flakes and the copper nanowires. To understand the oxidation and electronic structure of the synthesized copper hybrid, we have recorded linear polarized NEXAFS with the transmission x-ray microscope installed at the new U41-XM beamline of the BESSY II synchrotron, Berlin. [4,5] The spectra were normalized using the signal intensity in the proximity of the sample to correct for intensity variations with the photon energy. We observed that the oxidation of the copper nanowires is smaller when graphene is added to the synthesis.

References

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Figures

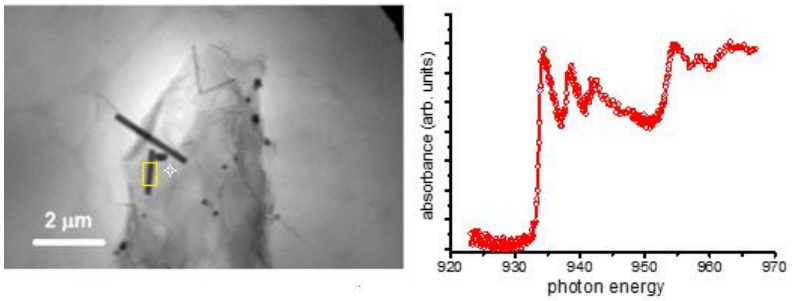

Figure 1: X-ray image at 950 eV photon energy from an image stack recorded on the graphene/copper nanowires composite at the U41 beamline by using the TXM. The NEXAFS–TXM Cu L-edge spectrum was recorded in the area delimited by the rectangle. The spot indicates the point at which the I0 was recorded