Abstract

This work demonstrates a suitable method for the functionalization of three-dimensional graphene samples with metal nanoparticles. The so-called 3D graphene is obtained by thermal decomposition of a porousified silicon carbide substrate in an ultra-high vacuum chamber. An accurate characterization of the graphenized porous samples has been performed via several techniques. The complex morphology of these samples was investigated by Scanning Electron Microscopy (SEM). Raman Spectroscopy was used to determine the quality of the grown graphene. Scanning Tunnelling Microscopy and Low Energy Electron Diffraction measurements gave direct evidence of the presence of graphene at the surface of the samples. Palladium metal nanoparticles have been synthesized, and an efficient process to make them diffuse into the pores of the sample has been found. The functionalization has been successfully performed also with gold nanoparticles. The functionalization process was analyzed by SEM imaging, Energy Dispersive X-ray Spectroscopy, and X-ray Photoemission Spectroscopy, revealing a uniform nanoparticle distribution on the surface and the diffusion of nanoparticles into the pores, even down to a depth of 20 μm. Furthermore, hydrogen storage experiments have been carried out to evaluate the difference in the uptake between unfunctionalized and functionalized samples. The storage capability and the binding energies of hydrogen atoms and molecules have been investigated by Thermal Desorption Spectroscopy.