STRUCTURAL STUDY OF HIGH SPECIFIC SURFACE GRAPHENE NANOWALLS GROWN BY INDUCTIVELY COUPLED PLASMA CHEMICAL VAPOR DEPOSITION

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Graphene nanowalls (GNWs) can be described as self-assembled, vertically standing, few-layered graphene sheet nanostructures. GNWs present singular characteristics, making them significantly different in many aspects from the conventional horizontal, randomly oriented graphene sheets. These structures possess a number of unique mechanical, chemical, electronic, electrochemical, and optoelectronic properties [1,2] that could benefit their potential use in a wide range of applications, like supercapacitors, lithium-ion batteries, sensors and solar cells[3].

The aim of the present report is to study the effect of different experimental plasma conditions in order to increase the specific surface of graphene nanostructures. Inductively coupled plasma chemical vapor deposition (ICP-CVD) was used for growing GNWs on c-Si wafers and polycrystalline foils of Cu and stainless steel in a temperature range between 550 and 850 ºC. Several growth parameters were explored: temperature, gas flow and gas mixture, pressure, plasma power, deposition time and cooling time. How these parameters affect the morphological and structural properties of the obtained GNWs were determined. Also, the plasma behavior and composition was studied through optical emission spectroscopy (OES) during growth.

The structural and morphological characterization of the obtained structures was done by scanning electron microscopy (SEM) and Raman spectroscopy.

The study of the Raman spectra showed that GNWs have high defect concentration and are based on multi-walled graphene. The density of GNWs increases with the increment of the temperature. Concerning the morphology influence of the different substrates used, while density and height of the GNWs were almost the same on c-Si and stainless steel substrates, on Cu foil they were shorter and less dense.

The present results show that we are able to tune the morphology of the GNWs by modifying the deposition parameters. This will allow the optimization of the structure to maximize its specific surface, and this will make GNWs samples suitable for electrochemical applications, where high specific surface and good conductivity are needed.

References

[1] Zheng Bo et al. , Nanoscale Journal, 5 (2013) 5180-5204.
[2] Keivan Davami et al., Carbon Journal, 72 (2014) 372-380.
[3] Xuefen Song et al., Materials Letters Journal, 137 (2014) 25-28.

Figures

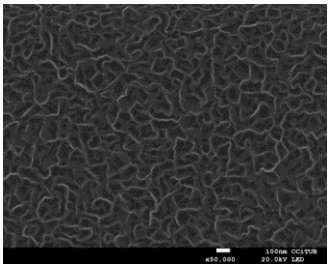

Figure 1: SEM image of GNWs on c-Si substrate.