Epitaxial Graphene on Si face of SiC: A Comparative Study of Different Growth Conditions

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Graphene, a two-dimensional sheet of carbon atoms arranged in a hexagonal lattice has attracted scientific community attention intensively due to its unique structural and electrical properties, particularly in the field of microelectronics. Mainly graphene could be obtained from the native source of graphene “top down” or source of carbon “bottom up” approaches which include: exfoliation from bulk graphite, chemical reduction of exfoliated graphite oxide, growth on SiC by silicon desorption, chemical vapor deposition on metal surface and metal surfaces with carbon solubility and carbon diffusivity. In order for graphene to become a viable technology, production on large scale and high quality material are two prerequisites therefore graphene growth by SiC sublimation represent an attractive route for large scale synthesis and compatibility with microelectronics technology. Very large areas of graphene can be obtained with the SiC sublimation method, therefore this technique represents an attractive route [1, 2]. However, at the moment the booming of this material is notably hampered by the low homogeneity of the number of layers all over the SiC substrate.

The studies presented in this poster are related to the optimization of growth of graphene on the Si face of 6H-SiC [3]. A comparative study of graphene growth under high vacuum or in inert media at atmospheric pressure will be discussed. In addition, evolution of surface morphology induced by annealing in presence of hydrogen at high temperature 1600°C (3°C/min) for 30 min and effect of such surface phenomena on graphene growth will be illustrated. In light of Raman and AFM studies (Fig. 1 and 2 respectively) conducted on a series of samples, it could be established that the annealing step combined to graphene growth under inert atmosphere at ambient pressure yields high quality graphene in terms of homogeneity, surface roughness and domain size on large areas. Such protocol was further investigated and the impact of sublimation time on graphene quality was studied. These experiments allowed achieving an optimized graphene synthesis protocol on Si face of SiC and hence obtaining quite large monolayer graphene domains (10 micron). In concern to the carrier mobility, it is highly dependent on graphene homogeneity and domain size. The recent reports state that samples with larger homogeneous graphene domains have two or three fold higher carrier mobility compare to samples exhibiting smaller graphene domains as surface steps and changes in layer thickness are key sites which seriously degrades transport in epitaxial graphene films on SiC [4]. Therefore in light of present experimental studies we can postulate that homogeneous graphene growth in optimal condition could also have high carrier mobility. The preliminary electrical measurements recorded on these graphene samples will be presented.

References:

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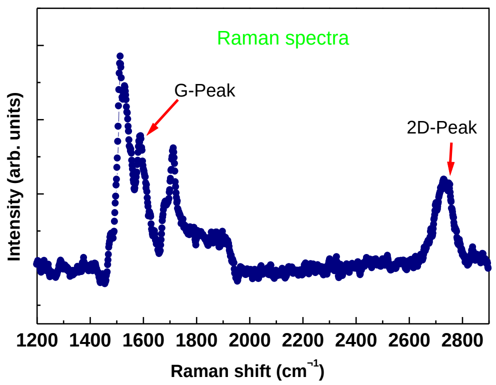

Figure 1: Raman spectra of graphene grown on Si face (annealed under H_2, growth at high T°C for 30 min).

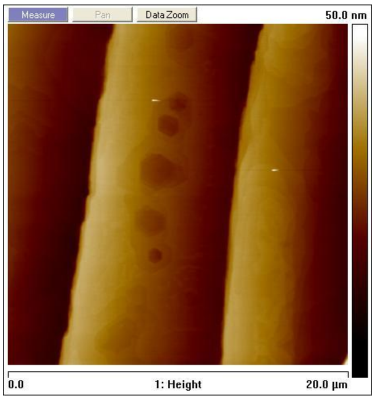

Figure 2: AFM image of grapheme grown on Si face (annealed under H_2, growth at high T°C for 30 min).