Direct low temperature growth of vertically oriented graphene nanowalls on multiple substrates by Low Temperature Plasma - Enhanced Chemical Vapor Deposition

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Abstract

Vertical graphene (VG) is intrinsically graphene, but it also possesses unique structural features, being arranged perpendicularly to the substrate surface. Individual VG nanostructure usually has lateral and vertical dimensions of 0.1 to tens of micrometers and a thickness of only few nanometers. Vertical graphene has a low operating temperature, which can be feasible for industrial applications. Plasma enhanced chemical vapor deposition (PECVD) is a key method for 3D graphene synthesis. The particular PECVD process presented here makes possible graphene deposition without the presence of catalyst and post-transfer treatment. In this study we have used one of the configurations of radio frequency (RF) PECVD: Inductively Coupled Plasma (ICP). As substrates materials we have used conductors and semiconductors. For each substrates we have obtained graphene nanowalls with different structures. The morphological and electrical properties of the obtained graphene nanowalls have been tailored by controlling the growth parameters, such as, plasma power, gas flow, temperature, pressure or cooling time. The characteristics of the VG samples have been analyzed by electrochemical measurements and BET. Also, the quality and porosity of graphene nanowalls have been determined by Raman spectroscopy and Scanning Electron Microscopy.

References

[1] Chongyin Yang, Hui Bi, Dongyun Wan, Fuqiang Huang, Xiaoming Xie and Mianheng Jiang, The Royal Society of Chemistry, Direct PECVD growth of vertically erected graphene walls on dielectric substrates as excellent multifunctional electrodes (2013)

[2] Xuefen Song, Jian Liu, Leyong Yu, Jun Yang, Liang Fang, Haofei Shi, Chunlei Du,Dapeng Wei, Materials Letters,Direct versatile PECVD growth of graphene nanowalls on multiple substrates (2014) 25–28

Figures

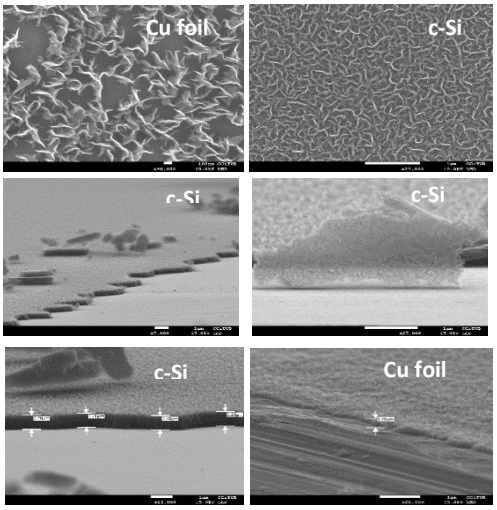

Figure 1. SEM images of VG grown on Cu foil and on c-Si