Growth of Graphene on 3C-SiC Nanostructures by UHV Annealing

Mojtaba Amjadipour*, Jonathan Bradford, Bharati Gupta, Jennifer MacLeod, Josh Lipton-Duffin, Nunzio Motta

School of Chemistry Physics and Mechanical Engineering, and Institute for Future Environment Queensland University of Technology – Brisbane 4001 – Australia

*Corresponding author: Email mojtaba.amjadipour@qut.edu.au

There is a growing body of literature that recognizes the potential of graphene for use in electronics [1]. However, the fact that graphene is a semimetal with zero bandgap is a key issue which challenges its remarkable range of applications [2]. Therefore, over the past few years, a considerable literature has grown up around the theme of producing a semiconducting graphene [3]. Thermal decomposition of SiC has proven to be an excellent method to grow transfer-free wafer-scale graphene [4]. Theoretical work suggests that a bandgap might be opened in graphene through quantum confinement, for example in graphene nanoribbons. In this research we attempt to manipulate the SiC substrate dimension to grow graphene over small nanostructures with lateral sizes ranging from tens of nm to 1 µm. To date, there has been no report about the growth of graphene on nanometer-scale SiC mesas, and very little is known about the effect of changing the dimension and characteristic of the substrate on which graphene is grown. In order to elucidate the possibility for patterned graphene-growth in substrate-defined geometries, we have examined the effect of SiC patterning on graphene growth. In Fig. 1a, we show a schematic of the basic experimental premise: mesa-patterned SiC/Si substrates with graphene ribbons grown over the mesas. SiC mesas were fabricated by patterning SiC/Si substrates using Focused Ion Beam (FIB) milling. Scanning Tunneling Microscopy (STM) was used to investigate the surface condition and to identify surface reconstructions produced during growth. In Fig 1b we observe the STM image of the patterned structures, and Moiré pattern can be seen in Fig 1c, confirming the growth of graphene.

Our results indicate the possibility of growing epitaxial graphene over a patterned SiC/Si substrate. We are continuing to investigate the impact of patterning procedure on the graphene growth and to optimize the structural quality of the pattern and the graphene.

Reference