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Direct Synthesis of Width-tailored Graphene Nanoribbon on Insulating Substrate

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Graphene has been emerged as a fascinating material for future nanoelectronic applications due to its extraordinally electronic properties. However, their zero-bandgap semimetallic nature is a major problem for applications in high performance field-effect transistors (FETs). Graphene nanoribbons (GNRs) with narrow widths ($\geq$ 10 nm) exhibit semiconducting behavior, which can be used to overcome this problem. In previous reports, GNRs were produced by several approaches, such as electron beam lithography patterning, chemically derived GNRs, longitudinal unzipping of carbon nanotubes, and inorganic nanowire template. Using these methods, however, the width distribution of GNRs was a quiet broad and substantial defects were inevitably occurred. Here, we report a novel approach for fabricating width-tailored GNRs by focused ion beam-assisted chemical vapor deposition (FIB-CVD). Width-tailored phenanthrene ($C_{14}H_{10}$) templates for direct growth of GNRs were prepared on SiO_2/Si substrate by FIB-CVD. The GNRs on the templates were synthesized at 900-1,050^{o}C with introducing CH_4 (20 sccm)/H_2 (10 sccm) mixture gas for 10-300 min. Structural characterizations of the GNRs were carried out using Raman spectroscopy, scanning electron microscopy, and atomic force microscopy.

Keywords: Graphene nanoribbon, Focused ion beam-asssisted chemical vapor deposition