SiO_2 膜でパッシベーションされたグラフェン FET への水素アニーリングの効果

Hydrogen Annealing Effect on Graphene Nanoribbon FET Covered by Silicon Dioxide Passivation Layer

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<u>Introduction</u>: Thermal annealing under the vacuum and/or hydrogen gas condition is known as the method to effectively remove absorbates and contaminant for graphene nanoribbon (GNR) devices [1]. In this study, we investigate the effect of hydrogen annealing on the GNR devices covered with SiO_2 passivation layer.

<u>Experiment</u>: Mechanical exfoliated bilayer graphene, identified by Raman spectroscopy, is deposited on the highly p-doped silicon substrate with thermally oxidized SiO_2. Graphene patterning, contact electrodes and deposition of SiO_2 passivation layer are defined using the conventional method. Three pairs of GNR devices, covered with/without SiO_2, lying on the same GNR are fabricated. Thermal vacuum annealing at 473K and hydrogen annealing at 573/623 K are conducted in a defined sequence, followed by instant electrical measurements at 300 K without breaking the high vacuum (lower than 10^{-2} Pa).

<u>Results and discussion</u>: Figure.1 shows the optical microscope picture of the fabricated GNR devices. Figure 2 plot the back-gate modulation characteristics of devices (a) without and (b) with the SiO_2 passivation layer. The difference in overall conductance between two types of devices is mainly attributed to the van der Waals bonds between the graphene π–orbitals and the evaporated SiO_2 [2]. By utilizing hydrogen annealing, heavily n-doped parabolic behavior of the GNR devices even covered with SiO_2 layer are observed. Poor conductance of the covered device before annealing is cured. Formation of a C-H bond is assumed as the reason of n-doping and increase of overall conductance. After exposure to ambient condition, the covered device maintains better minimum conductance than the uncovered device, but stronger charge trapping, indicating by the hysteresis, is also observed on the covered device due to the increase of the SiO_2-trapped charges from the interface of SiO_2 passivation layer and graphene.

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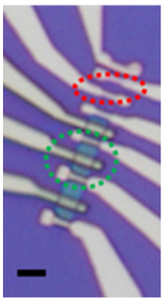

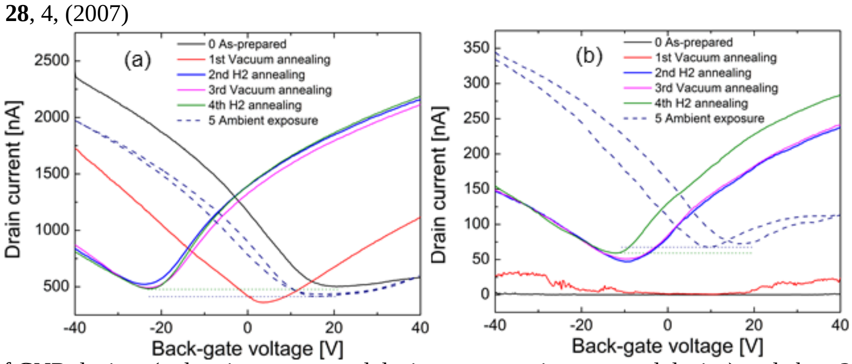

Fig. 1 Optical microscope of GNR devices (red region: uncovered device; green region: covered device) scale bar: 2 um.

Fig. 2(a) and (b) Back-gate modulation characteristics of bilayer GNR devices without and with SiO_2 passivation layer