T1-001

Control of Graphene's Electrical Properties by Chemical Doping Methods

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This study examined the synthesis of large area graphene and the change of its characteristics depending on the ratio of CH4/H2 by using the thermal CVD methods and performed the experiments to control the electron-hole conduction and Dirac-point of graphene by using chemical doping methods. Firstly, with regard to the characteristics of the large area graphene depending on the ratio of CH4/H2, hydrophobic characteristics of the graphene changed to hydrophilic characteristics as the ratio of CH4/H2 reduces. The angle of contact also increased to 78° from 58°. According to the results of Raman spectroscopy showing the degree of defect, the ratio of I(D)/I(G) increases to 0.42% from 0.25% and the surface resistance also increased to 950 Ω/sq from 750 Ω/sq. As for the graphene synthesis at the high temperature of 1,000° by using CH4/H2 in a Cu-Foil, the possibility of graphene formation was determined as a function of the ratio of H2 included in the fixed quantity of CH4 as per specifications of every equipment. It was observed that the excessive amount of H2 prevented graphene from forming, as extra H-atoms and molecules activated the reaction to C-bond of graphene. Secondly, in the experiment for the electron-hole conduction and the Dirac-point of graphene using the chemical doping method, the shift of Dirac-point and the change in the electron-hole conduction were observed for both the N-type (PEI) and the P-type (Diazonium) dopings. The ID-VG results show that, for the N-type (PEI) doped graphene, Dirac-point shifted to the left (-voltage direction) by 90V at an hour and by 130 V at 2 hours respectively, compared to the pristine graphene. Carrier mobility was also reduced by 1,600 cm2/Vs (1 hour) and 1,100 cm2/Vs (2 hours), compared to the maximum hole mobility of the pristine graphene.

Keywords: CVD graphene FET, P&N type doping graphene, Electrical Properties of graphene