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Optimization of Copper Surface as a Substrate for CVD growth of Graphene

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Copper (Cu) foil substrate is the most widely used as a substrate for graphene growth by chemical vapor deposition (CVD). It is known that the suitable morphology and crystal orientation of Cu foil substrate, which are crystal plane of Cu (111), low roughness and large grain size, are required for the growth of good film uniformity of graphene. The purpose is to investigate the evolution of surface morphology and crystal orientation of Cu foil substrate, after various chemical treatment and annealing at high temperatures (800 –1000^{o}C). Before a real growth of grapheme, we firstly focus on a preparation the Cu foil substrate by pretreatment in hydrochloric acid (HCl) and electro-polishing in phosphoric acid (H_3PO_4) in order to removing impurities on Cu foil surface. To increase the grain size of the (111) domains on the Cu foil substrate, after chemical cleaning process, the Cu foil substrates were annealed under nitrogen gas atmosphere. Scanning electron microscopy (SEM), optical microscopy (OM), atomic force microscopy (AFM) and x-ray diffraction spectroscopy (XRD) were utilized to investigate surface morphology and crystal orientation of the Cu foil substrate, that need to be optimized for the CVD growth of graphene. OM, SEM and AFM images illustrated an improvement surface of Cu foil substrates after pretreatment in HCl with the optimized concentration of 37% and etching time of 40 s. The conditions of electro-polishing was adjusted to be 50% H_3PO_4, voltage of 10 V, and polishing time of 60 s for achieving the smoothest Cu foil substrate surface. Furthermore, the strongest X-ray diffraction intensity ratio between the (111) reflection to other reflections, such as (200), (220) and (311) reflections, was observed for the Cu foil substrate annealed at 920 ^{o}C and 2 mbar for 5 min. In addition, heat increasing rate, cooling rate and N_2 flow rate were 1 ^{o}C /s, 5 ^{o}C /s and 20 sccm, respectively. Graphene growth and its characterization results will discussed during presentation.

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