Modification of Dirac point in graphene-based field effect transistor by nitrogen-doping

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Field effect transistors (FETs) with modified Dirac points have been fabricated from large-area graphene (20 x 20 mm\textsuperscript{2}). The nitrogen-doped graphene was synthesized on copper foil by chemical vapor deposition (CVD). The ammonia gas decomposed to ions as nitrogen source in our CVD system, and the nitrogen-doped graphene configurations were controlled by different substrate biases. The three prominent peaks of N1s in X-ray photoelectron spectroscopy (XPS) are pyridinic N (398.5-399.9 eV), pyrrolic N (400.1-401.0 eV) and quaternary N (401.6-402.3 eV). In comparison with p-type graphene, the percentage of pyridinic N was larger than that of quaternary N in n-type graphene which is due to cracks or defects in graphene surface. The electrical properties showed that the Dirac point graphene-based FET shifted from 5 V (p-type) to -9 V (n-type) when the applied bias (+10 V) turned to negative bias (-10 V) during graphene growth. The carrier mobility could reach to 558.3 cm\textsuperscript{2}/V·s for hole conduction and 49.9 cm\textsuperscript{2}/V·s for electron conduction, respectively, as shown in Figs. 1(a) and 1(b).

Fig. 1. I-V curves and N1s XPS spectra of graphene with different substrate bias: (a) -10 V and (b) +10 V.