ST-P017

Angle-Resolved Photoemission Spectroscopy and Raman Spectroscopy Study on the Quasi-free Standing Epitaxial Graphene on the 4H SiC(0001) surface

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The epitaxial graphene on the 4H- or 6H-SiC(0001) surface has been intensively studied due to the possibility of wafer-scale growt. However the existence of interface layer (zero layer graphene) and its influence on the upper graphene layer have been considered as one of the main obstarcles for the industrial application. Among various methods tried to overcome the strong interaction with the substrate through the interface layer, it has been proved that the hydrogen intercalation successfully passivate the Si dangling bond of the substrate and can produce the quasi-free standing epitaxial graphene (QFEG) layers on the siC(0001) surface. In this study, we report the results of the angle-resolved photoemission spectroscopy (ARPES) and Raman spectroscopy for the QFEG layers produced by ex-situ and in-situ hydrogen intercalation.From the ARPES measurement, we confirmed that the Dirac points of QFEG layers exactly coincide with the Fermi level. The band structure of QFEG layer are sustainable upon thermal heating up to 1100 K and robust against the deposition of several metals andmolecular deposition. We also investigated the strain of the QFEG layers by using Raman spectroscopy measurement. From the change of the 2D peak position of graphene Raman spectrum, we found out that unlike the strong compressive strain in the normal epitaxial graphene on the SiC(0001) surface, the strain of the QFEG layer are significantly released and almost similar to that of the mechanically exfoliated graphene on the silicon oxide substrate. These results indicated that various ideas proposed for the ideal free-standing graphene can be tested based on the QFEG graphene layers grown on the SiC(0001) surface.

Keywords: Quasi-free standing graphene, ARPES, Raman spectroscopy