IBS Center for Multidimensional Carbon Materials

Tuesday Colloquium

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Exploring the growth of graphene and related 2D materials for electronic applications

Tuesday, AUG 30
4 PM

Bldg. 101
Seminar room on the 1st floor

Graphene possesses unique physical properties which promise applications in various electronics devices, such as touch panels, sensors, and wearable devices. Recently, catalytic chemical vapor deposition (CVD) growth has attracted a considerable interest as an effective means to produce large-area single-layer graphene films. However, because most of the CVD growth has been done over polycrystalline Cu foils, as-grown graphene has relatively small domain size and its orientation is not controlled. Here, I present our original heteroepitaxial CVD approach, in which crystalline metal films deposited on single-crystalline substrates, such as c-plane sapphire, are used to grow single-layer graphene (Fig. 1) [1-4]. The heteroepitaxial metal films enable the growth of graphene whose hexagon orientation is controlled by the underlying metal lattice. Low energy electron microscope investigation revealed that the graphene sheets grown on Cu(111) and Cu(100) have different domain structures [5,6]. Large hexagonal graphene domains with controlled orientation were obtained on the Cu(111) [7]. We also found that inter-domain mobility is lower than that of intra-domain mobility even for the domains merged with the same angle (Fig. 2) [8]. Further, we have recently achieved selective growth of bilayer graphene on Cu-Ni alloy deposited on sapphire [9]. Finally, our recent studies on the direct epitaxial CVD growth of heterostructures of graphene and transition metal dichalcogenides (TMDCs) is also presented (Figs. 3,4) [10-12]. Optical response is applied to graphene transistors. This method has been developed to visualize grain structures of 2D materials including graphene and WS2 [13].

[1] H. Ago, ACS Nano, 4, 7407 (2010). [2] B Hu, Carbon, 50, 57 (2012). [3] C. M. Orofeo, Carbon, 50, 2189 (2012). [4] C. M. Orofeo, Nano Res., 4, 531 (2011). [5] Y. Ogawa, J. Phys. Chem. Lett., 3, 219 (2012). [6] H. Ago, J. Phys. Chem. Lett., 3, 2228 (2012). [7] H. Ago, Appl. Phys. Express, 6, 75101 (2013). [8] Y. Ogawa, Nanoscale, 6, 7288 (2014). [9] Y. Takesaki, Chem. Mater. 28, 4583 (2016). [10] W. Ge, Nanoscale, 5, 5773 (2013). [11] H. Ago, ACS Appl. Mater. Interfaces, 7, 5265 (2015). [12] R. M. Yunus, Phys. Chem. Chem. Phys. 17, 25210 (2015). [13] H. Ago, ACS Nano, 10, 3233 (2016).

You are cordially invited to attend!