IT-003

Novel Synthesis and Nanocharacterization of Graphene and Related 2D Nanomaterials Formed by Surface Segregation

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Nanosheets of graphene and related 2D materials have attracted much attention due to excellent physical, chemical and mechanical properties. Single-layer graphene (SLG) was first synthesized by Blakely et al in 1974 [1]. Following his achievements, we initiated the growth and characterization of graphene and h-BN on metal substrates using surface segregation and precipitation in 1980s [2,3]. There are three important steps for nanosheet growth; surface segregation of dopants, surface reaction for monolayer phase, and subsequent 3-D growth (surface precipitation). Surface phase transition was clearly demonstrated on C-doped Ni(111) by in situ XPS at elevated temperatures [4]. The growth mode was clarified by inelastic background analysis [5]. The surface segregation approach has been applied to C-doped Pt(111) and Pd(111), and controllable growth of SLG has been demonstrated successfully [6]. Recently we proposed a promising method for producing SLG fully covering an entire substrate using Ni films deposited on graphite substrates [7]. A universal method for layer counting has been proposed [8]. In this paper, we will focus on the effect of competitive surface-site occupation between carbon and other surface-active impurities on the graphene growth. It is known that S is a typical impurity of metals and the most surface-active element. The surface sites shall be occupied by S through surface segregation. In the case of Ni(110), it is confirmed by AES and STM that the available surface sites is nearly occupied by S with a centered 2×2 arrangement. When Ni(110) is doped with C, surface segregation of C may be interfered by surface active elements like S. In this case, nanoscopic characterization has discovered a preferred directional growth of SLG, exhibiting a square-like shape (Fig. 1). Also the detailed characterization methodologies for graphene and h-BN nanosheets, including AFM, STM, KPFM, AES, HIM and XPS shall be discussed.

References

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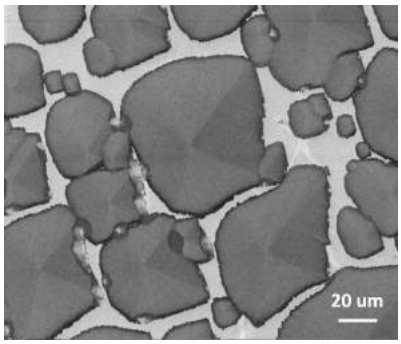

Fig. 1 Helium ion microscopy image of rectangular-shaped singlelayer graphene formed on C-doped Ni(110).

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