A Facile CVD Synthesis of BN Doped Graphene Using Boric Acid and Nitrogen Gas

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Abstract

Chemical doping of graphene has been shown to be an effective way of permanently modulating the electronic properties in single layer graphene. Several theoretical studies have shown that simultaneous incorporation of B and N in graphene is thermodynamically possible yielding small planar hexagonal boron nitride (*h*-BN) domains in graphene and most importantly that this process achieves band gap modulation in graphene.[1] The band gap opening in graphene, due to doping with BN, has been attributed to the breaking of localized symmetry. Here we demonstrate a facile, safe process for the chemical vapour deposition synthesis of BN doped graphene on copper using methane, boric acid powder and nitrogen gas, revealing that the B and the N are incorporated within the graphene structure forming a B-N-C system. We provide a simple reproducible experimental method to synthesize large area BN doped graphene which can be used to make high quality BN doped graphene for possible applications in nanoelectronic devices. Optical microscopy confirmed that continuous films were grown and XPS confirmed that both B- and N- can be substituted into the graphene structure in the form of BN to give a B-N-C system. A novel structure for the BN doped graphene is proposed.

References

[1] Fan, X.; Shen, Z.; Liu, A.Q.; Kuo, J. *Nanoscale,* **4** (2012), 4, 2157-2165.

Figures

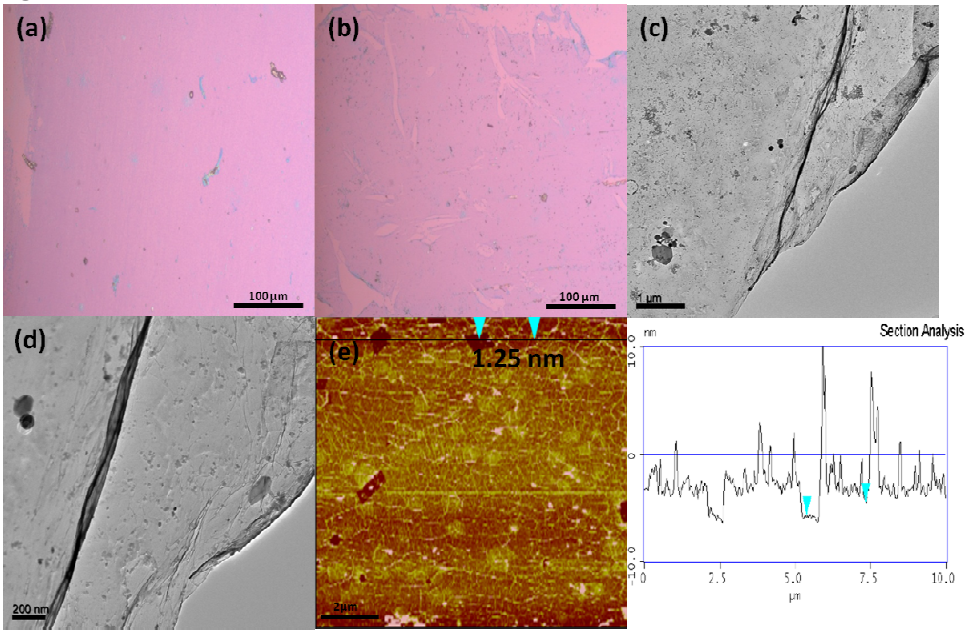

Figure 1. Graphene and BN doped graphene films grown on Cu using boric acid and nitrogen gas. (a) Optical images of pristine graphene transferred onto SiO_2/Si substrate. (b) Optical image of BN doped

graphene transferred onto a SiO_2/Si substrate. (c) Low-magnification TEM image of BN doped graphene on a plain Cu TEM grid showing a continuous graphene film. (d) High-magnification TEM image of BN doped graphene on a plain Cu grid showing small particles of Cu and Fe remaining after the etching process. (e) AFM image of BN doped graphene showing wrinkled graphene, and (f) AFM section analysis of BN graphene showing an average film thickness of 1.25 nm.

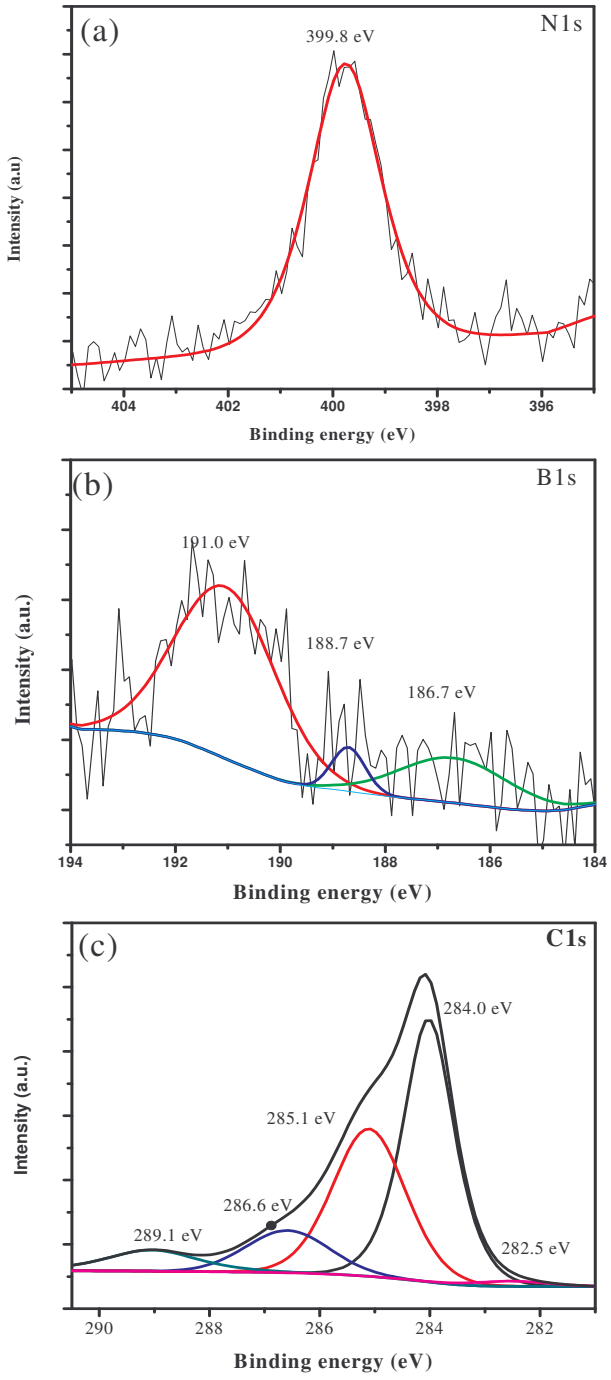

Figure 2. High resolution XPS spectras measured on BN doped graphene showing (a) the N1s core level revealing only a single peak at 399.8 eV, (b) B1s core level with three peaks at ca. 191.0, 188.7 and 186.7 eV of BN, BC_3 and B_4C respectively and (c) the C1s core level, obtained from BN doped graphene