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The Structure and Air Stability of Calcium and Magnesium Intercalated Graphene on 6H-SiC(0001)

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Calcium intercalated graphene has been shown to exhibit superconductivity below 2 K, yet its structure has remained elusive in the literature to date. Furthermore, the intercalation of Mg underneath epitaxial graphene on SiC(0001) has not been reported. In this talk, epitaxial monolayer graphene samples synthesised on 6H-SiC(0001) are utilised to investigate calcium and magnesium intercalated graphene. By making use of low energy electron diffraction, X-ray photoelectron spectroscopy and secondary electron cut-off photoemission techniques available at the Australian Synchrotron Soft X-ray Beamline, and the scanning tunnelling microscope at Monash University, we are able to elucidate the structure of these intercalated systems.

We find that Ca intercalates underneath the buffer layer and bonds to the Si-terminated SiC surface,breaking the C–Si bonds of the buffer layer, i.e., "freestanding" the buffer layer to form Ca-intercalated quasi-freestanding bilayer graphene (Ca-QFSBLG). The situation is similar for the Mg-intercalation of epitaxial graphene on SiC(0001), where an ordered Mg-terminated reconstruction at the SiC surface is formed and Mg bonds to the Si-terminated SiC surface are found, resulting in Mg-intercalated quasi-freestanding bilayer graphene (Mg-QFSBLG). Ca-intercalation underneath the buffer layer has not been considered in previous studies of Ca-intercalated epitaxial graphene. Furthermore, we find no evidence that either Ca or Mg intercalates between graphene layers. However, we do find that both Ca-QFSBLG and Mg-QFSBLG exhibit very low work functions of 3.68 and 3.78 eV, respectively, indicating high n-type doping. Upon exposure to ambient conditions, we find Ca-QFSBLG degrades rapidly, whereas Mg-QFSBLG remains remarkably stable.

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