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Growth of graphene under layers: A wafer-scale Bernal-stacked bilayer graphene and graphene foam by atmospheric pressure chemical vapor deposition

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In this work, we present a simple approach to demonstrate that subsequent layers of graphene grown between the existing monolayer graphene and the copper catalyst in Chemical Vapor Deposition (CVD) by forming multilayer graphene islands with a structure of an inverted wedding cake. The topographic analyses of the as-grown CVD graphene on Cu foil revealed the under layer growth of subsequent layers, where the smaller graphene layers (or islands) lie above the larger layers stacked in a concentric manner. Consequently, the results of the as-grown CVD graphene support the formation of the inverted wedding cake stacking in multilayer graphene growth. Due to the major interest in the AB-stacked bilayer graphene film which stems from its unique band structure with a tunable band gap which determines transport and optical properties; the Atmospheric Pressure Chemical Vapor Deposition (AP-CVD) growth of monolayer and bilayer graphene on pure Cu foils and dilute Cu (Ni) foils were studied. This study clearly shows the capability of a dilute Cu (Ni) foil for growing a wafer (substrate)-scale high-quality bilayer graphene film compared to a pure Cu foil which is known to grow bilayer islands on a monolayer graphene background in chemical vapor deposition. This work contributed to the on-going research on the growth of large-area highquality AB-stacked bilayer graphene films on metal substrates using CVD. Furthermore, this work also reports on the confocal Raman spectroscopy and imaging of graphene foam prepared on Ni and Ni (Cu) foam using AP-CVD. The confocal Raman spectroscopy imaging of graphene on Ni foam revealed variation in the number of layers, i.e. monolayer, bilayer and few-layer graphene. To reduce the number of layers in the as-grown graphene foam the Ni foam was doped with Cu foil. From a Ni foam doped with Cu (Ni (Cu) foam), a graphene foam showed only monolayer and bilayer with a large fraction of the bilayer (???75% coverage). This graphene/Ni (Cu) foam sample may have a potential as a high-current response current collector for super capacitor applications.

Biography:

Ncholu Manyala is Professor of Physics and Chair of South African research chair initiative (SARChI) in Carbon Technology and Materials at the University of Pretoria, South Africa. Prof. Manyala got his PhD from Louisiana State University working in low temperature transport and magnetic properties of strongly correlated materials where he published two papers in Nature and one in Nature Materials in this field. Prof. Manyala's recent research interest is on nano-carbon based materials and their applications in energy storage and sensing. Prof. Manyala has published more than 60 papers in this subject. Prof. Manyala is the member of International Society of Electrochemistry, South African Microscopy Society and South African Institute of Physics.

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