Graphene–Graphdiyne Heterostructure: Synthesis and Resistive Switching Behavior

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Abstract

A two-dimensional (2D) heterostructure is a functional material engineered by vertically assembling distinct 2D materials, enabling tailored interlayer interactions. Graphdiyne (GDY), an allotrope of carbon, is one of the most stable members of the graphyne family. Unlike graphene, GDY consists of benzene rings interconnected by diacetylene (diyne) linkages [1]. In 2010, Li et al. first synthesized GDY film by an in situ cross-coupling method on copper foil [2]. Due to its inherent porosity, hydrophobicity, and semiconducting properties, GDY has been explored for various applications, including energy storage, gas separation, water desalination, water remediation, and optoelectronics. A graphene/graphdiyne heterostructure integrates the high electrical conductivity of graphene with the semiconducting carbon framework of GDY, enabling synergistic properties suitable for advanced electronic and energy-related devices. In this study, a modified synthesis route using a copper trichloro complex is employed to fabricate this heterostructure [3]. Here, we report the successful growth of ABC-stacked graphdiyne on CVD-synthesised graphene using a solution-based method at ambient conditions. Notably, crystalline GDY preferentially forms on graphene, exhibiting a thickness approximately one order of magnitude lower than GDY grown on bare copper. We explored the resistive-switching behaviour of this crystalline GDY layer grown on graphene [4]. Graphene serves the dual purpose of facilitating the formation of a conformal crystalline GDY film and simultaneously acts as the bottom electrode in the resistive switching device. Using copper as the top electrode, the heterostructure exhibits resistive switching governed by a valence change conduction mechanism (VCM), operating within a narrow voltage window.

References

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Figures

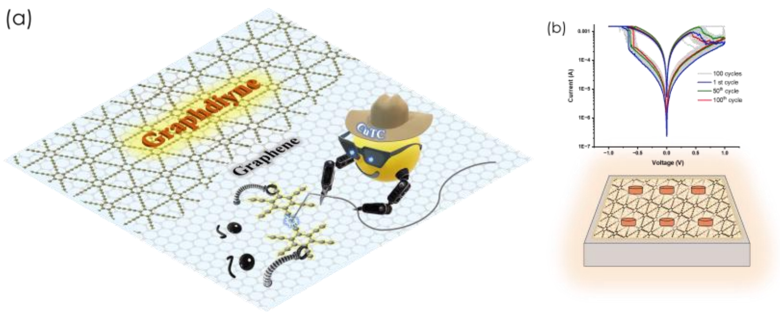

Figure 1: (a) Synthesis of Graphene-GDY heterostructure, (b) Resistive switching performance