Encapsulation of Graphene Nanoribbons in Hexagonal Boron Nitride using Dry-Transfer Method

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Mechanical exfoliation and van der Waals stacking of atomically thin materials have become significant experimental methods for functional 2D materials heterostructure fabrication. The so-called van der Waals (vdW) heterostructures exhibit weak vdW interactions between the layers and strong interatomic connections within the 2D materials; for instance, graphene and hexagonal boron nitride (hBN) that can be mechanically exfoliated from bulk crystals. The dry transfer method using polydimethylsiloxane stamps is acknowledged as an adaptable and flexible approach, enabling the clean assembly of exfoliated flakes for fabricating encapsulated devices [1]. Graphene nanoribbons (GNRs) have gained significant interest for quantum applications and nanoelectronics, particularly field-effect transistors, due to their tunable band gap and width-dependent electrical and optical characteristics, which can be achieved through controlled bottom-up synthesis using precursor polymerization [2]. Encapsulating graphene between hBN flakes minimizes SiO_2 substrate-related drawbacks, improves device quality and fabrication, enhances mobility, and enables micrometre-scale ballistic transport at room temperature. Encapsulated aligned 7-armchair graphene nanoribbons (7-AGNRs) are fabricated to investigate the influence on electronic transport and optical properties. After the growth of GNRs on Au (788) and their transfer to substrates such as SiO_2, dry transfer of 7-AGNRs remains a significant challenge in GNR-based device fabrication [3]. We will present the first vdW heterostructures with encapsulated aligned GNRs utilizing the dry-transfer method to transfer 7-AGNRs; we used Raman spectroscopy to confirm the high quality of the samples. The encapsulated 7-AGNRs heterostructures alongside twisted 7-AGNRs bilayer pave the way for effective templates for merocyanine templating, promoting long-range molecular order in π-conjugated organic compounds adlayers [4].

References

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Figures

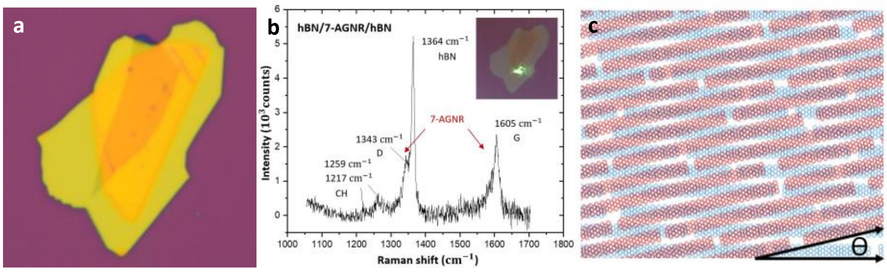

Figure 1: (a) 7-AGNRs encapsulated between two hBN flakes with graphite backgate using dry transfer, (b) Raman spectra of encapsulated 7-AGNRs between hBN flakes, (c) Illustration of the Moiré pattern within the Twisted 7-AGNRs bilayer.