Graphene nanoribbon transfer roadmap

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Graphene nanoribbons (GNRs) exhibit exciting properties deriving from electron confinement and related band gap tunability[1]. The ability to tune GNRs' electronic and magnetic properties at the single atom level makes them an ideal platform for a wide range of device applications, ranging from classical transistors to spintronics. However, such realization necessitates the transfer of GNRs from their metallic growth substrates onto an electrostatically gateable one.

Our work focuses to establish a roadmap for substrate transfer of the GNRs after on-surface synthesis (OSS) in ultra-high vacuum (UHV). Various wet[2] and semi-dry/dry-transfer techniques have been actively pursued allowing efficient integration of armchair edged ribbons into electrostatically controlled devices showing promise as high ON/OFF transistors[3], tunable quantum dots[4], etc. Additionally, interest also lies in transferring zigzag-edged GNRs, which host exotic edge states for device integration. However, such GNRs with reactive edges are sensitive to the ambience, warranting a UHV compatible transfer methodology. To address this, several stamp-based techniques (polymer, Au, 2D materials) analogous to the ones used for 2D transfer have been explored both with an in-house automated transfer setup, and by implementing the KISS method[5]. Further, to negate the bottleneck of strong interaction of the on surface synthesized GNRs with the underlying Au, intercalation techniques with AuCl and $CrCl_3$ to decouple the GNRs from the Au have also been implemented to facilitate the "pickup" of these ribbons.

References

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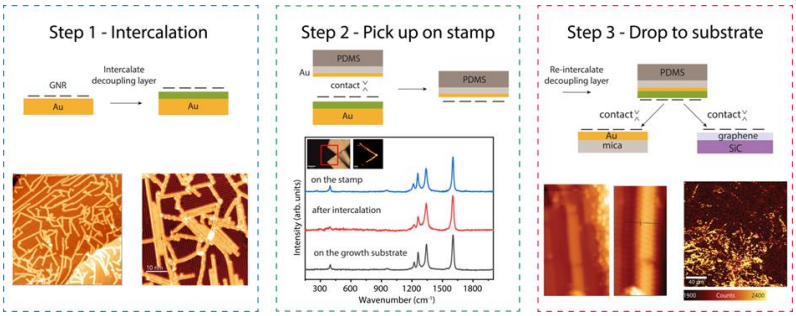

Figure 1 – Steps for realizing transfer of the GNRs from the growth substrate to the gateable substrates (growth and intercalation - left panel, pickup with stamp – middle panel, drop – right panel)