A Spin-Coatable Dry Transfer Method of 2D Materials

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In recent years, researchers have tried to develop various methods to synthesize high-quality large-scale graphene and 2D materials using chemical vapor deposition (CVD) processes.[1] However, transferring and patterning steps during the fabrication of the 2D materials often degrade the electrical performances, because, for example, a conventional transfer method using poly (methyl methacrylate) (PMMA) leaves PMMA residue on the surface of the 2D materials, leading to undesirable doping effect. Moreover, acetone used to remove PMMA damages organic layers.[2] Thermal release tapes (TRT) also cause considerable contamination. Thus, it is needed to develop a new transfer technology to solve the above-mentioned problems.[3]

Here we report a novel transfer method based on the use of pressure sensitive adhesive (PSA) that can be simply spin-coated on the sample, and completely removed by peeling-off after the transfer, which is expected to allow the use of soluble layers for various 2D device fabrication processes. We confirmed that the sheet resistance of graphene has not been altered after transfer thanks to the good adhesion between graphene and PSA layers. In addition, the transparent graphene FETs transferred by PSA shows high charge carrier mobility compared to the FETs transferred by PMMA or thermal release tapes (TRT), implying that the graphene surface is ultra-clean without residues after the removal of PSA. TMDCs including WS_2 and MoS_2 were successfully transferred on a lens for smart glasses applications by PSA with minimized contamination. In addition, using PSA enables simpler patterning process eliminating the need for using photo or e-beam lithography. Thus, we believe that the current method is applicable to various flexible and wearable applications that have been limited by wet transfer conditions for more practical and larger scale device fabrications of 2D materials.

References

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Figures

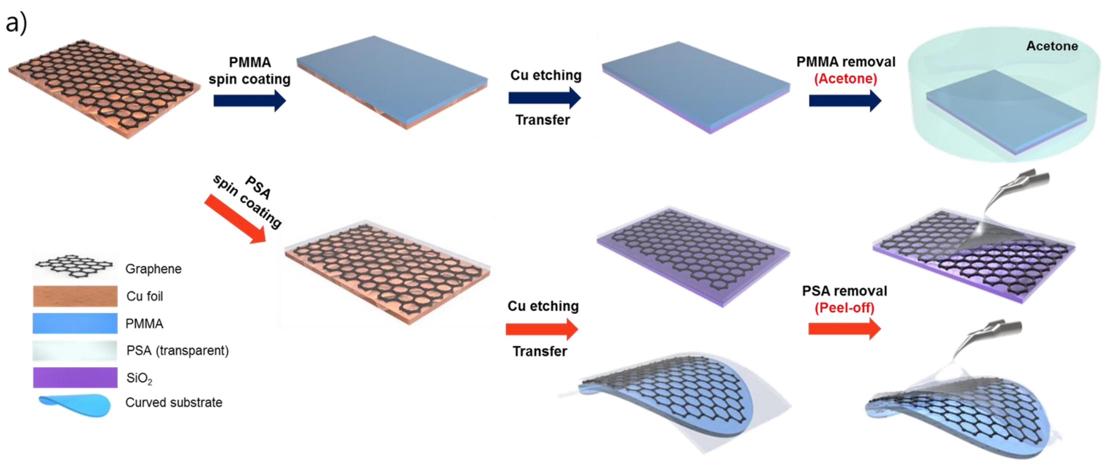

Figure 1: Comparison between PMMA spin coating method and PSA spin coating method