Direct transfer of wafer-scale graphene films

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Graphene is the most promising candidate for transparent and conductive layers as its flexibility together with electrical and thermal properties makes it unique and compatible to many applications. Chemical vapor deposition (CVD) growth of graphene appears as a cost-effective method satisfying all requirements to utilize graphene in real-life applications, since it allows obtaining uniform wafer-scale layers [1]. However, transfer of graphene from catalytic growing substrate to insulating one and its processing is one of the most advantageous research area of graphene nowadays.

Here, we report about a method of graphene transfer onto flexible substrate requiring only two essential steps: CVD deposition of poly-para-xylylene polymer (better known as parylene) on 6-inch monolayer CVD graphene, and copper (Cu) removal [2]. Figure 1a illustrates schematic of the direct transfer process. The direct deposition induces no physical or thermal stress to graphene from the gas phase at room temperature. Parylene plays roles both as a supportive layer during Cu removal and an insulating substrate. Figure 1b shows wafer-scale transferred graphene on parylene. SEM images in Figure 1c show that the transferred graphene layers are highly continuous and uniform. Combined transmission and sheet resistance values of our graphene/parylene films as low as 50 Ω/sq and 96.5% transparency at 550 nm are superior to common transparent electrodes such as ITO (Fig.2a). Figure 2b demonstrates the excellent stability of the films electromechanical properties against large bending deformations of up to 6% strain and after 2000 bending cycles.

References

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Figures

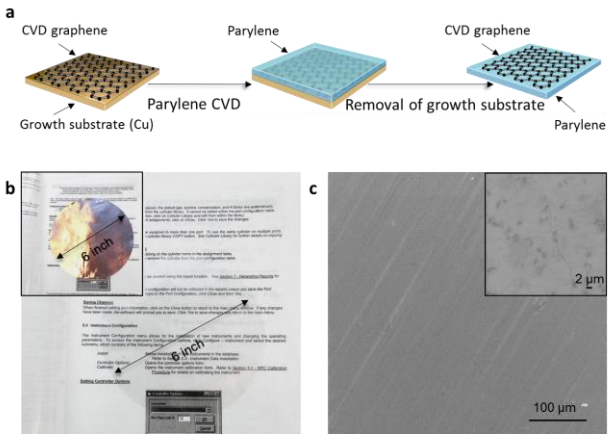

Figure 1: a, Schematic of the parylene based graphene transfer. **b**, Graphene on 25µm thick parylene film after removal of Cu foil. Inset: Graphene on Cu foil covered with parylene. **c**, SEM images of graphene on parylene.

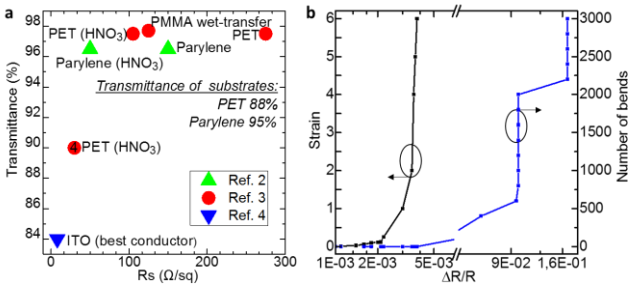

Figure 2: a, Comparison to previous results of Rs vs T% plot for graphene only. **b,** Log-scaled ΔR/R versus strain and bending number.