Clean graphene transfer via cyclododecane: a superior approach to PMMA-assisted methods

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The transfer of graphene grown by chemical vapor deposition is a post-growth process crucial for the fabrication of any graphene-based device. The atomically thin graphene can be easily fractured, folded and contaminated during the transfer process, seriously compromising its applicability in high-end technology [1]. Robust and intrinsically clean protective layers to be used during the transfer process are still actively sought after to maintain the graphene films intact and with its pristine electronic properties. Currently, poly methyl methacrylate (PMMA) resist is the most frequently used supporting film for transfer [2]. Although PMMA is highly effective in providing mechanical stability and keeping the film intact, its removal requires the use of solvents and is not entirely successful due to its residues, which alter the electronic properties of graphene [3]. A thermal annealing is additionally used for further cleaning of the transferred graphene, but this step can damage graphene and leave behind indissoluble residues.

Cyclododecane ($C_{12}H_{24}$) can be considered a viable alternative to PMMA during the transfer process [4]. It is a non-toxic and eco-friendly organic compound that can be easily spin coated on graphene and assist transfer, leaving no contamination traces and requiring no further removal treatments. This transfer method was successfully used in photovoltaic devices such as Schottky-barrier [5] and organic solar cells [6], confirming its effectiveness. In this work, we present a systematic study to further optimize the cyclododecane-assisted transfer method. We successfully transferred both continuous polycrystalline films on large area and individual graphene crystals (a few µm in size). The morphological features of transferred graphene is assessed by scanning electron microscopy and atomic force microscopy, while its crystalline quality is evaluated by Raman spectroscopy and mapping.

References

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Figures

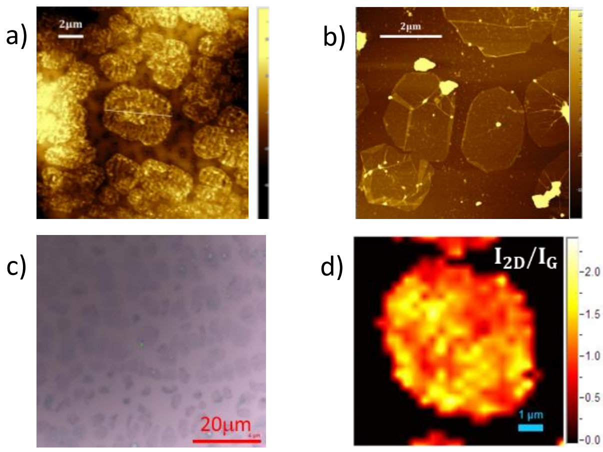

Figure 1: AFM images of graphene domains as grown on copper (a) and transferred on Si/SiO$_2$ substrate (b). (c) Optical image of domains transferred on Si/SiO$_2$. (d) Raman scanning map of I_{2D}/I_G intensity ratio of a single graphene domain on Si/ SiO$_2$.