# Multifunctional polymer film in graphene transfer

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Chemical vapour deposition (CVD) of graphene has been recognized a key technology for large are graphene production [1]. By CVD, graphene is grown on a transient metal substrate and thereafter transferred on a dielectric substrate. During the transfer process, a graphene film is conventionally supported by a layer of poly(methyl methacacrylate) (PMMA) which is then removed after the transfer [1]. Since PMMA is a widely used electron-beam resist material, it offers an interesting idea to use this resist layer for graphene transfer and patterning simultaneously.

In our experiment, we synthetized graphene on a copper foil by a conventional CVD technique [2]. The copper foil/graphene was spin coated with a long chained PMMA based resist and the Cu foil was removed by wet etching. We transferred then the graphene/PMMA film on an oxidized silicon. Thereafter, the supporting PMMA was patterned by electron-beam writer and developed in methyl isobutyl ketone. The PMMA resist mask was then coated by an evaporated 80 nm thick Cu film. By removing PMMA in acetone, we performed a lift-off and obtained a metallic mask on graphene. The metallic mask protected graphene during oxygen dry etching. Finally, the metallic mask was removed by wet etching revealing the patterned graphene on the oxidized silicon substrate. The process is described illustrated in Fig. 1.

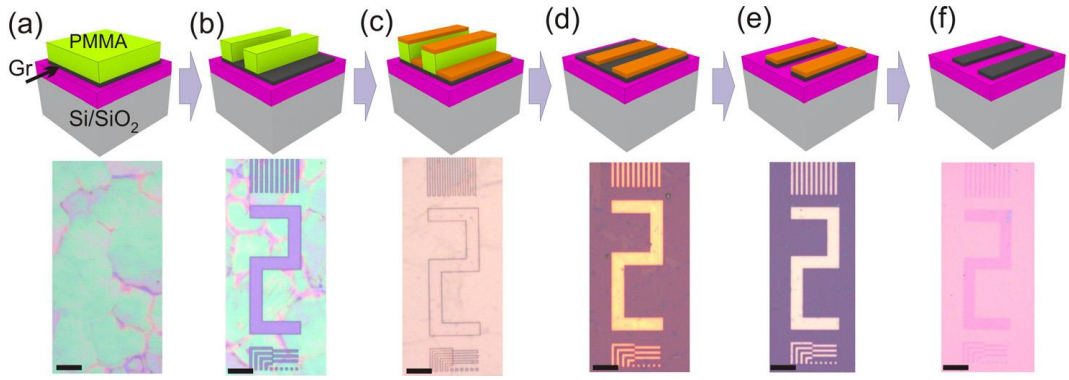


Figure 1. Schematic illustration (and corresponding optical microscope images) of the graphene transferring and patterning by using the one and same PMMA film on both processes. (a) At first graphene/PMMA is transferred on a substrate and (b) the PMMA support is patterned by electron-beam lithography. (c) The patterned PMMA is coated by a thin copper film. (d) The PMMA is removed resulting a Cu mask for (e) graphene patterning by reactive ion etching. (f) At the end, Cu mask is removed by wet etching. (Scale bar is 20 µm.)

In summary, we have presented a simple and straightforward technique to pattern graphene by using the same PMMA film in graphene transfer and patterning. Despite, the graphene film was exposed to focused electron beam and relatively high doses we did not observe any damage or defects in graphene proving the technique to be safe for graphene [2]. Thus, we believe, this method could provide a nice technological platform for graphene post-processing.

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## References

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