Clean transfer of Large-Area Suspended Graphene membrane

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Abstract

Nanopores in 2D materials can be considered close to idealized filters[1]. They have almost no thickness and their properties can be tuned by the size of the pores as well as the decorations on the edges of the pores[2]. The actual data to support these claims and to build devices should come from measurements of individual pores, which can be observed under varied conditions. Instead, in literature most of the studies describe data that is *averaged* over a distribution of sizes and edge decorations. As a result, the conditions of critical importance, e.g. when pore sizes are close to the species passing through them, are hard to analyze. To remedy this deficiency, here, we report a scalable way to fabricate high-quality suspended graphene supported on patterned microholes, which can be embedded in microfluidic devices for observations. Nanopores made with appropriate areal density on graphene can yield single pores suspended on a microhole. The process uses a robust photoresist (Ostemer-Litho) that is coated on a Cu foil and then exposed and developed with an array of microholes. The copper is etched and the resulting cured photoresist layer is fished on top of a graphene-coated Cu foil. The Cu foil is again etched leading to graphene attached to the photoresist. This layer is then fished on top of the bottom half of a two-layer microfluidic chip. After drying it, the chip is exposed to oxygen plasma to make nanopores in graphene. The top half of the microfluidic chip is aligned and bonded on the bottom layer, sandwiching the graphene and resist layer in between. Finally, the fluidic chip is subjected to flow and electrical characterization.

References
[1] Shihao Su, Xinwei Wang, Jianming Xue,Royal Society of Chemistry,161(2021)1390-1408.
[2] Ryan C. Rollings1, Aaron T. Kuan, Jene A. Golovchenko1, Nature Communications,22 (2016),11408.

Figures

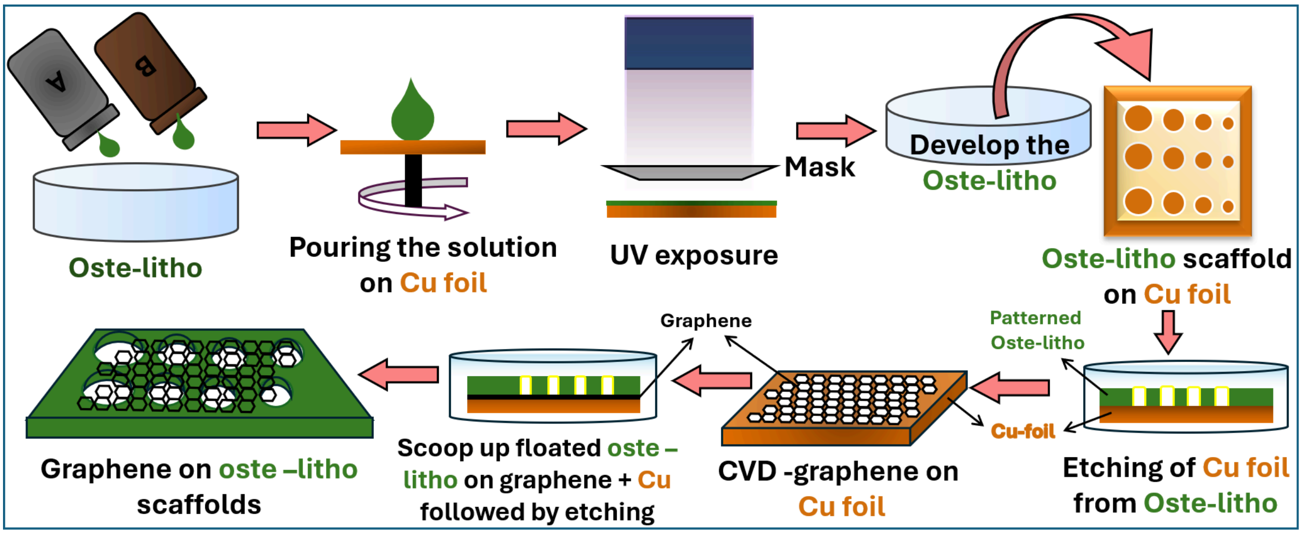

Figure 1: Schematic representation of graphene transfer and suspension on Oste-litho.