Fabrication and characterization of bored nanopores in graphene films

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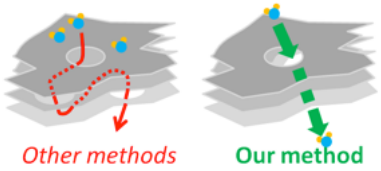
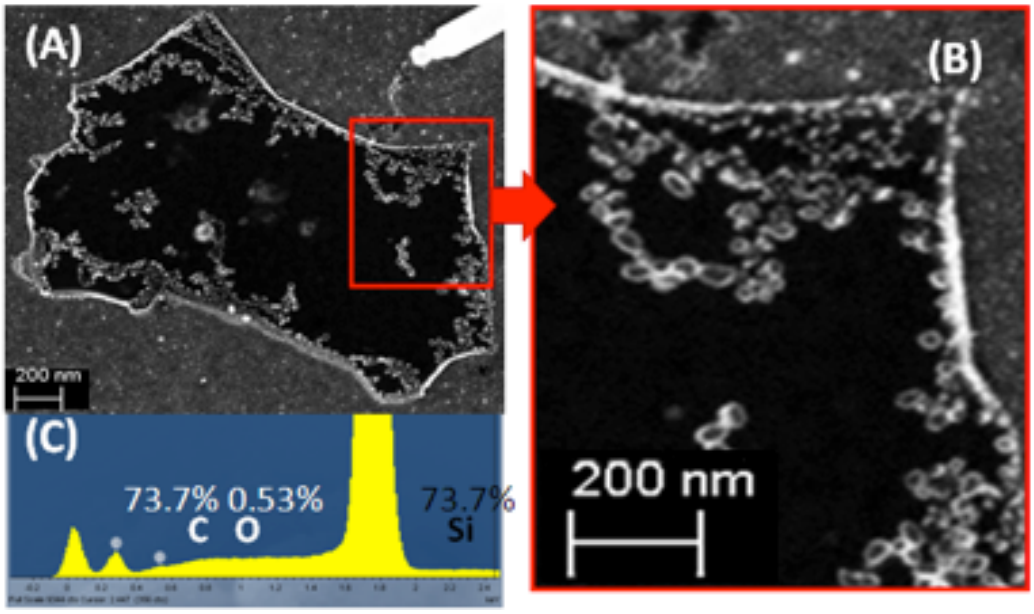
Porous graphene is a two-dimensional material that is potentially interesting for a large variety of applications in water purification and microfiltration. Porous graphene filters can be used as a selective filter because it is not only the pore size, but also the chemical functional groups attached to the pore edges that control the water filtration characteristics. We developed a proprietary method for fabricating nano-sized holes in few-layer graphene. Differently from the most commonly used techniques for achieving pores in graphene, bored holes through an entire multilayer are obtained with our technique.

High filtration rates at relatively low differential pressure are a possible through our hollow graphene flakes, as opposed to impractically low filtration rates through "traditional porous graphene". By controlling the size of the pores, we are able to selectively filter water through graphene while retaining larger and undesired molecules of contaminants.

Scanning Electron Microscopy (SEM) and Electron Dispersive X-ray (EDX) spectroscopy at the Western University Nanofabrication Faculty were used to verify the opening of holes in graphene films which are seen as white hollow dots in the SEM images (see Figure below). EDX measurements are useful to determine the composition of the functional groups attached at the edge of the pores, as well as estimating the presence of contaminants from the pore fabrication methods. We are now in the process of developing a scalable method to prepare large-diameter filters based on collections of graphene platelets in which the entire amount of filtrated liquid passes through the pores, with negligible contributions from leaks from the interconnection between the flakes. This step requires filling our graphene flakes with specific resins and will open up the possibility to commercially utilize our filters.

This project will bring important benefit to solving a large number of environmental issues and to understanding the interaction between nano-sized molecules and graphene.





(A) SEM Inlens image of nano-pores (white and hollow dots) on graphene film on silicon substrate and (B) its magnified image. (C) EDX spectrum on the pores

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