Membranes of 2D Materials and Capillaries for Mass Transport

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Abstract

In the last decade, atomically thin capillaries made from 2D materials have created a wave of new research especially in hydrodynamics and mass transport properties of fluids [1,2].Van der Waals assembliy of 2D materials to make capillaries, such as graphene, molybdenum disulphide and hexagonal boron nitride has already been achieved, but require highly sophisticated environments and nanofabrication techniques such as e-beam lithography, dry etching, and photolithography, and are very time consuming as we make one device at a time [1,2]. Herein, we are presenting an unique and novel nano-fabrication process to prepare 2D channels with well-defined geometries in a scalable manner. This technique demonstrates the fabrication of 2D channels from different naturally occurring layered materials such as graphite, metal oxides and sulphide, transition metal dichalcogenides, and phyllosilicates have been prepared in mass production, but in a shorter period. In addition, this method can be applied to prepare 2D channels from different 2D nanosheets such as graphene, molybdenum disulphide and hexagonal boron nitride through Van der Waals assembly. Moreover, this process holds advantages in making 2D channels of different dimensions and shapes with angstrom-scale precisions, alongside of the reduction of time and fabrication cost. The construction of these 2D channels will open doors to upscale production of nanofluidics devices, which can greatly impact studying and understanding the fundamental properties of fluids in confined geometries.

References

[1] Radha, B., et al. 'Molecular transport through capillaries made with atomic-scale precision'. Nature 538,222–225 (2016).
[2] A. Esfandiar., et al. 'Size Effect in Ion Transport through Angstrom-Scale Slits', Science, 358, 511-513 (2017).

Figures

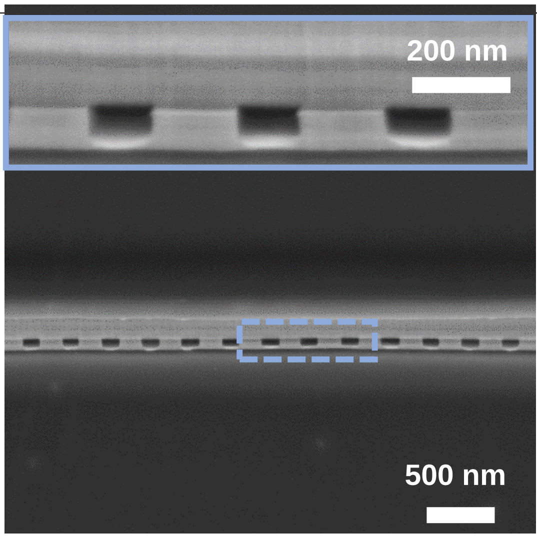

Figure 1: Cross-sectional scanning electron microscopy image of 2D channels fabricated by our method.