Anodic Alumina Oxide (AAO) as hard mask for graphene nanomesh(GNM) fabrication

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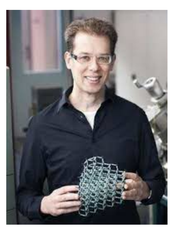

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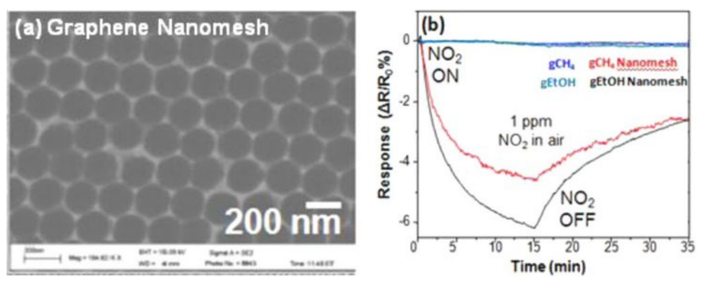
GMN extends the toolbox of carbon-based applications

Gas sensing



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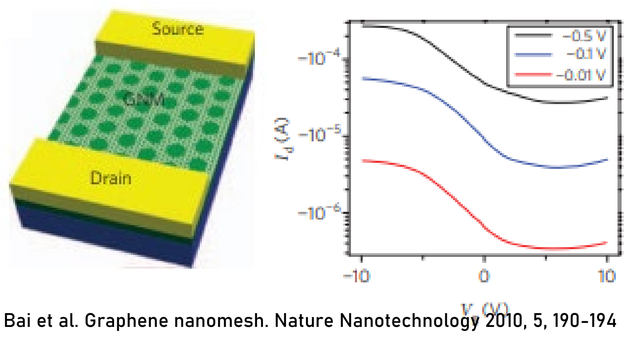
Electronic devices



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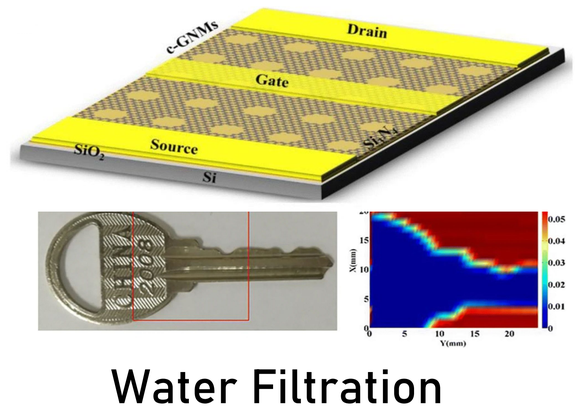
Optical detector



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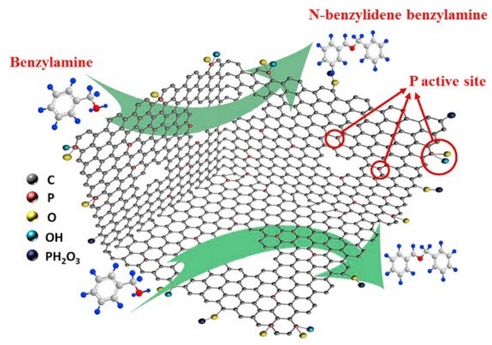
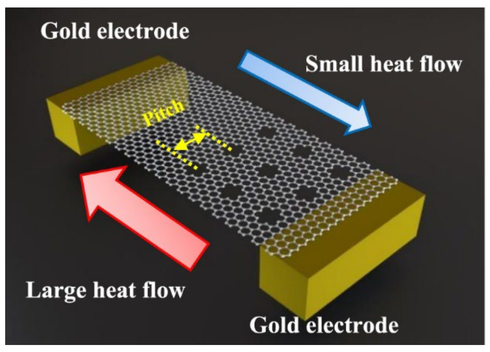
Catalysis



F. Yang et al. P-doped nanomesh graphene with high-surface-area as an efficient metal-free catalyst for aerobic oxidative coupling of amines. *Carbon* 2017, *121*, 443-451

Thermal rectifier



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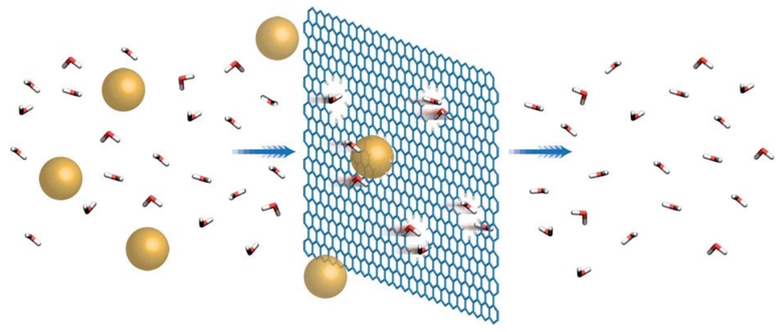
Water Filtration



E. Wang and R. Karnik. Graphene cleans up water. Nature Nanotechnology 2012, 7, 552-554.

Defective? Sometimes is better.

To take full advantage of the functionality of 2D materials precise engineering of structural defects are crucial. Periodically ordered nano-perforated graphene structures lead to the formation of a graphene nanomesh (GMN). In this configuration, defects can be considered as structural arrangements that can be exploited for specific functionalities, rendering the GMN a promising material for the implementation in a broad range of applications such as electrochemical and optical sensing, filtration, electronics devices, energy conversion/storage or catalysis.

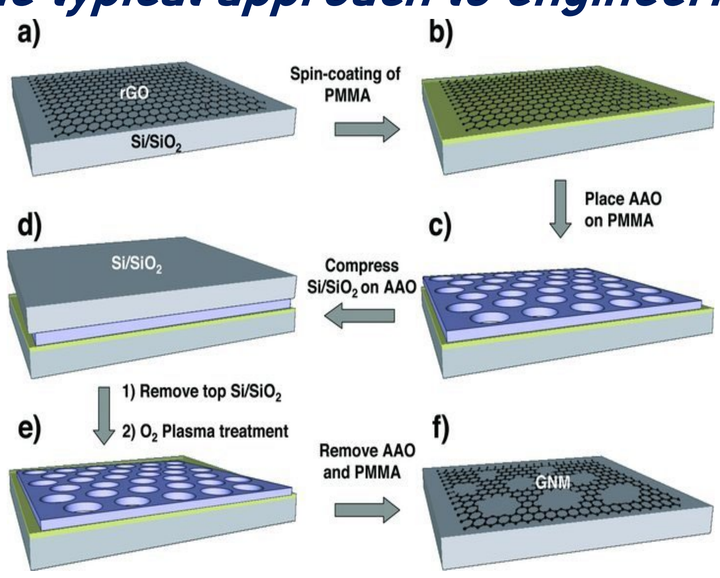
Engineering the GNM using a AAO

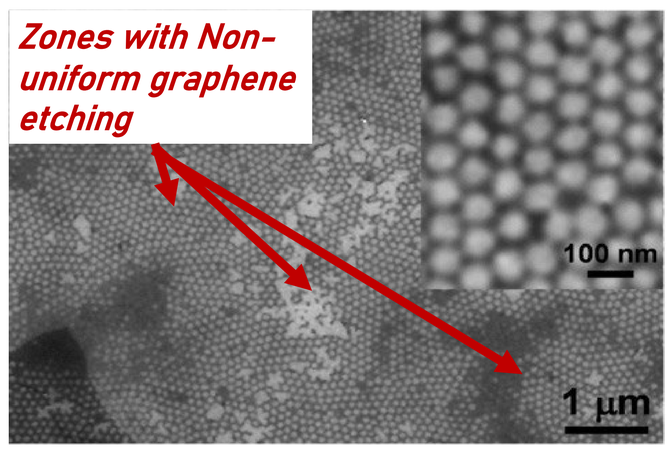
Large-area GMN has been prepared using AAO membrane as an etch mask in which a plasma process is applied to selectively etch the exposed graphene surfaces. In the reported works, the AAO is placed on top of the graphene films. However, AAO is a brittle material that complicates their manipulation. Besides, bad contact on the interphase of the AAO/graphene can induce inhomogeneous etching structures.

AAO properties

- Hexagonal close-packed arrangement, forming a honeycomb-like structure
-AAOs are tunable in wide ranges by adjusting anodization conditions. Pore diameters between 10-250 nm and pore density 10^8–10^{10} pores cm^{-2}.
- Diverse nanostructures can be obtained by periodic modulations.
-Cost-effective method, relatively simple implementation

The typical approach to engineering GMN using AAO as a hard mask

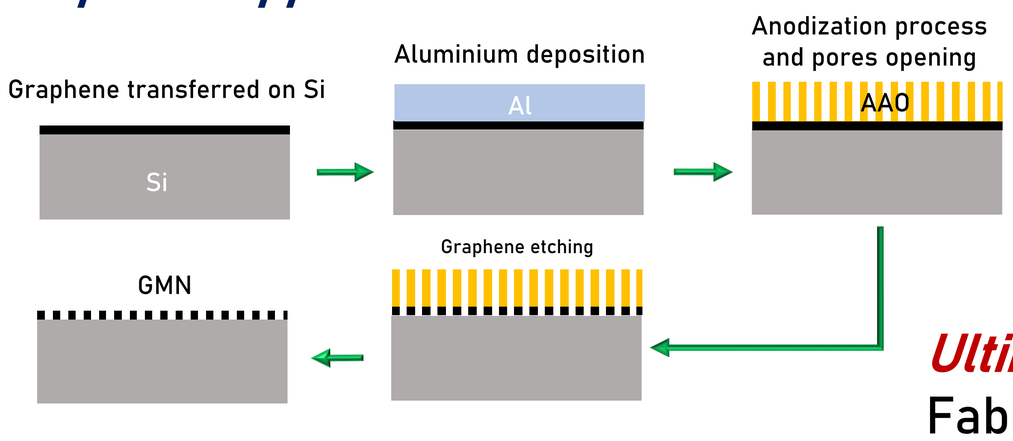




Z. Zeng et al. Fabrication of Graphene Nanomesh by Using an Anodic Aluminum Oxide Membrane as a Template. Advanced Materials 2012, 24, 4138-4142,

Innovation and challenges

Proposed approach



Fabrication and characterization

- Sputtering aluminium layer on top of a graphene film.
- Stop pore growth formation close to the graphene.
- Evaluate the film thickness on the graphene etching.
- Monitor the graphene quality through the process.
- Electrical measurements on GMN.

Ultimate goal:

Fabricate a large-area GMN with tunable pore sizes and characterize the electrical transport properties