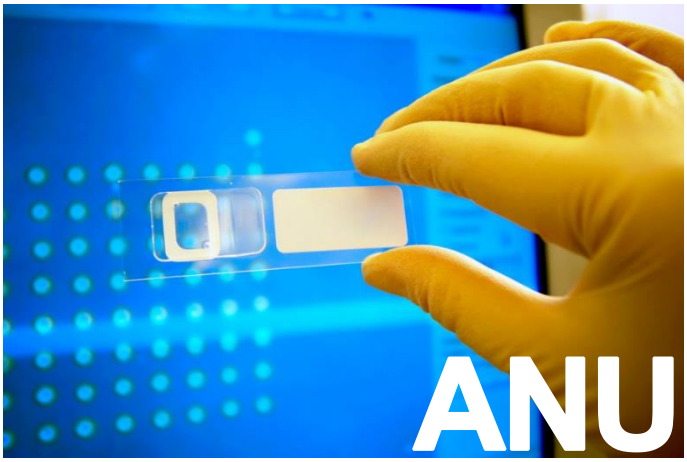
Australian National University

TECHNICAL SUMMARY

Versatile and Scalable Methods for Fabricating Solid State Membranes and Nanopores



In recent years, nanopore technology has become increasingly important in the field of life science and biomedical research. Development of highly scalable, flexible, and industrially viable methods for fabricating nanopores in thin solid-state membranes has been a long-standing challenge for scientists in the field.

Our researchers at Australian National University (ANU) have recently made a significant breakthrough in this area by inventing a novel method for creating membranes of materials including silicon dioxide, silicon oxynitride, silicon nitride, diamond including multi-layers of different materials. Furthermore, they have created scalable and flexible methods for fabricating nanopores in these membranes.

For the fabrication of nanopores, the ANU method involves a new etching process that eliminates the need for the highly toxic and corrosive hydrofluoric acid (HF) typically used in nanopore fabrication. The new process allows for more precise control over the size, shape, and opening angles of nanopores, which cannot be achieved using current fabrication methods. The ability to customize the radius, depth, and shape of nanopores makes this method highly tuneable, and it can be used to fabricate multi-layered gated nanopore membranes.

Potential benefits

> **Versatile:** Able to control nanopore shape and size
> **Scalable:** Fabrication uses readily available components and materials and a manufacturing process that is suitable for industrialisation
> **Safer:** Replaces highly toxic and corrosive HF acid used in current track-etch technology with a safer, less acidic alternative, reducing risks for workers and less regulation requirements
> **Stable:** Allows the fabrication of robust and stable nanopores from a single pore to 10^{10} pores per cm^2
> **CMOS-compatible:** Works with silicon-based CMOS-compatible membranes which can be readily integrated into devices

Potential applications

> Bio and Chemical Sensing
> Size and charge selective separation
> DNA sequencing
> Protein separation and detection
> Nanofluidic logic devices

Opportunity

ANU team is exploring partnering opportunities with: 1) Manufacturer of nanopore membranes, 2) Provider of nanopore membranes, 3) Provider of devices that include nanopore membranes, with the goal to refine the technology.

The technology is effective and requires minimal development to modify it to meet specific commercial manufacturing processes. This can be facilitated through leveraging research grant schemes in Australia.

Publications

https://doi.org/10.1021/acs.analchem.2c05751

https://onlinelibrary.wiley.com/doi/10.1002/smtd.202300676

IP status

The IP is owned by ANU and is the subject of a patent application.

PCT/AU2022/051467 and PCT/AU2022/051466

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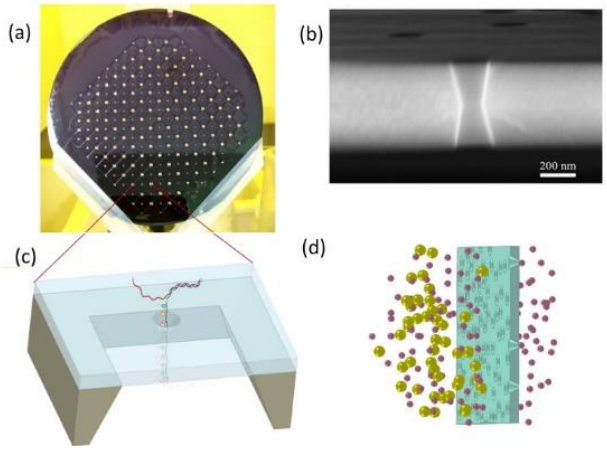

Figure 1: (a) Photograph of Si wafer with membranes of different sizes; (b) SEM cross-section of nanopore; (c) Biomolecule sensing; (d) Selective separation.