

# 高 pH 水溶液中での絶縁破壊を用いた、広範囲のサイズ調整が可能なナノポア形成方法

## Stable fabrication of a large nanopore by controlled dielectric breakdown in a high-pH solution for the detection of various-sized molecules

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For nanopore sensing of various-sized molecules with high sensitivity, the size of the nanopore should be adjusted according to the size of each target molecule. For solid-state nanopores, a simple and inexpensive nanopore fabrication method utilizing dielectric breakdown of a membrane is widely used. This method is suitable for fabricating a small nanopore. However, it suffers two serious problems when attempting to fabricate a large nanopore: the generation of multiple nanopores [1,2] and the non-opening failure of a nanopore [3]. In this study, we found that nanopore fabrication by dielectric breakdown of a SiN membrane under high-pH conditions ( $\text{pH} \geq 11.3$ ) could overcome these two problems and enabled the formation of a single large nanopore up to 40 nm in diameter within one minute (Fig. 1).

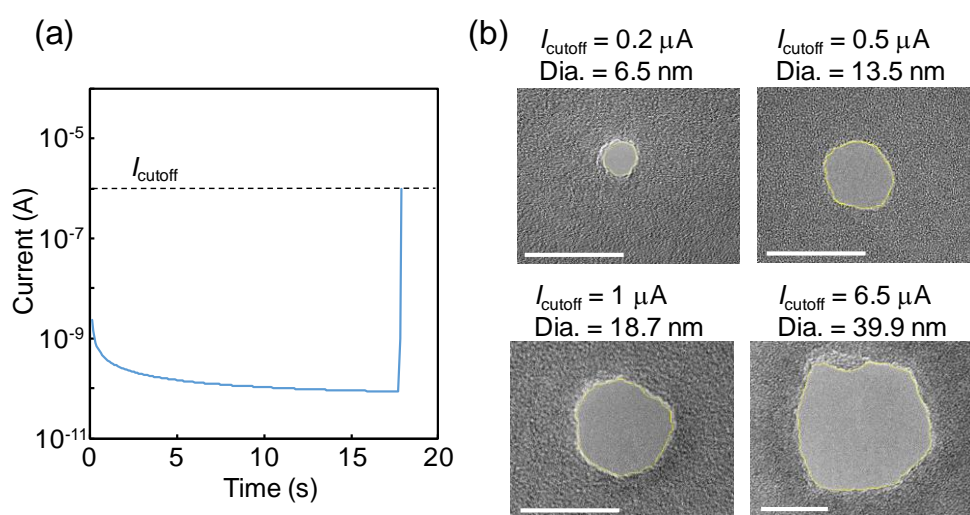


Fig. 1. (a) Current-time trace until dielectric breakdown of a SiN membrane in a KCl aqueous solution with a pH of 12.7. The applied voltage and the thickness of the SiN membrane were 18 V and 20 nm, respectively. (b) TEM images of nanopores created in the SiN membranes. The diameter of the fabricated nanopores could be controlled within a range of 5 to 40 nm by changing the cutoff current ( $I_{\text{cutoff}}$ ). Scale bars are 20 nm.

### References

- [1] Wang, Y. *et al.*, *Sci. Rep.* **8**, 1234; DOI:10.1038/s41598-018-19450-7 (2018).
- [2] Carlsen, A. T. *et al.*, *Nanotechnology* **28**, 085304 (2017).
- [3] Yanagi, I. *et al.*, *Sci. Rep.* **8**, 10129 | DOI:10.1038/s41598-018-28524-5 (2018).