

課題番号 : F-21-IT-021
 利用形態 : 技術代行
 利用課題名(日本語) : 無機材料ナノポアを用いた単鎖 DNA シーケンサーの製作
 Program Title (English) : Development of single-stranded DNA sequencer using a solid-state nanopore
 利用者名(日本語) : 徐偉倫、王志軒
 Username (English) : Wei-Lun Hsu, Zhixuan Wang
 所属名(日本語) : 東京大学工学系研究科機械工学専攻
 Affiliation (English) : Department of Mechanical Engineering, The University of Tokyo
 キーワード/Keyword : リソグラフィ・露光・描画装置、ナノ細孔アレイ、DNA シーケンサー

1. 概要(Summary)

In this program, high-resolution e-beam lithography is used for the fabrication of nanopore arrays on ultrathin inorganic membranes for high throughput, which is a critical step for the experiment for the development of high-resolution solid-state nanopore systems for molecule sensing applications.

The chips with inorganic (SiN) membrane are bought from Alliance Biosystems (model No.: SN200-A30Q33), on which there are nine windows (100 $\mu\text{m} \times 100 \mu\text{m}$) covered with 30 nm-thick SiN membrane. On each window, a nanopore array (1,444 nanopores with a diameter of 66 nm) is going to be fabricated by EB lithography.

2. 実験(Experimental)

【利用した主な装置】

電子ビーム露光装置 (スピンのコータ・ホットプレート・オーブン等を含む)

【実験方法】

1. Glue the chip to a wafer (15 mm \times 15 mm) with adhesive PMGI SF6.
2. Resist coating: Spin-coat a 100 nm-thick layer of electron sensitive resist PMMA (1:2) (170 $^{\circ}\text{C}$, 20 min) on top of the chip.
3. EB exposure: Pattern the layer by exposing the resist with electron bundle (100 keV, 100 pA, dose: 100–900 $\mu\text{C}/\text{cm}^2$) from the EB pattern generator. (With pretest on Si.)
4. Development: Develop the PMMA in a 1:3 mixture of MIBK for 1 min and IPA for 45 s.

3. 結果と考察(Results and Discussion)

Fig. 1 shows the chip coated with PMMA on a wafer. Fig. 2 shows an EB exposure result of nanopore array on a SiN membrane. But the diameter does not meet the target diameter as shown in Fig. 3. Next, we will adjust the dose and the diameter in the CAD exposure pattern to meet the target diameter.

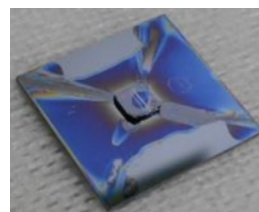


Fig. 1 The chip coated with PMMA on a wafer.

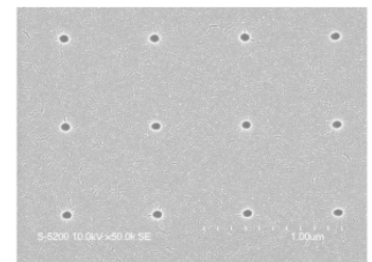


Fig. 2 The EB exposure of nanopore array on a SiN membrane.

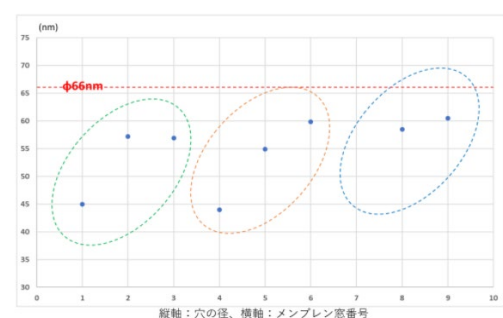


Fig. 3 The difference between the pore diameter after EB exposure and the target diameter. Dose: 550 (green), 600 (red), and 650 (blue) $\mu\text{C}/\text{cm}^2$ for each group. The pore diameters set in every group are 60, 65, and 70 nm, respectively (No.7 is broken).

4. その他・特記事項(Others)

なし。

5. 論文・学会発表(Publication/Presentation)

なし。

6. 関連特許(Patent)

なし。