課題番号　　:F-17-TU-0049
利用形態　　:機器利用
利用課題名（日本語）　　:MEMS/NEMS fabrication
Program Title (English)　　:MEMS/NEMS fabrication
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キーワード／Keyword　　:膜加工・エッチング，Metal assisted chemical etching (MACE), nanochannels

1. 概要（Summary）

Nanopores with approximate 15 nm-diameter and 200 μm-height were successfully fabricated by MACE as well as the electrically driven ion transportation was demonstrated. The proposed fabrication method and structure show a great potential for manipulations of ions and may be useful in chemical analysis, biological processes, electrochemical supercapacitor, and thermoelectric power generator.

2. 実験（Experimental）

【利用した主な装置】

. Vapor HF エッチング装置
. 多元材料原子層堆積（ALD）装置
. メタル拡散炉
. Sandblast
. 両面アライナ露光装置一式

【実験方法】

Thin Ag film is deposited on a 200 μm-thickness silicon wafer. The wafer is then annealed to de-wet the Ag film into a monolayer of Ag particles. Next, the wafer is immersed in a mixture solution of HF and H_2O_2. Ag particles go down by etching Si and the nanopores will be formed. The nanopore diameters can be determined by Ag particle diameters which depend on Ag film thickness. Smaller particle sizes can be achieved using the thinner deposited Ag film

3. 結果と考察（Results and Discussion）

Forming nanopores with approximate 15 nm-diameter through the wafer have been achieved, as shown in Fig. 1.

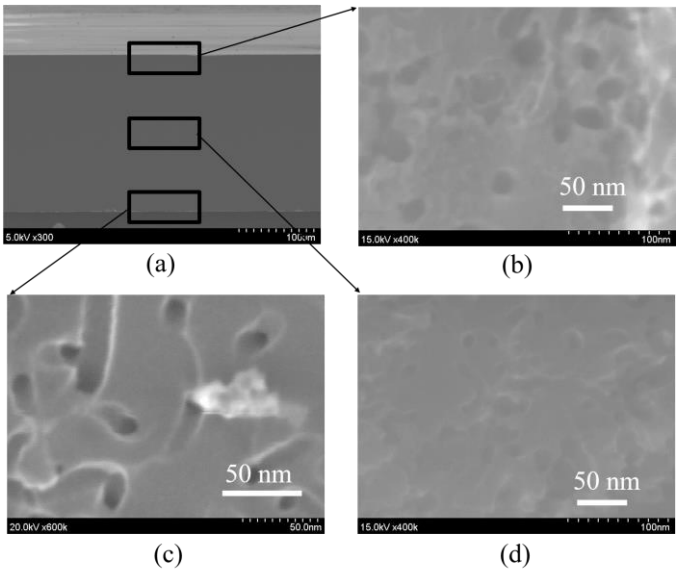

Figure 1. Fabricated results. (a) Cross sectional view of wafer after MACE. (b) Top area-cross sectional view. (c) Bottom area-cross sectional view. (d) Middle area-cross sectional view.

4. その他・特記事項（Others）

なし

5. 論文・学会発表（Publication/Presentation）

(1) N.V. Toan, N. Inomata, M. Toda and T. Ono, “Electrically driven ion transport in nanopores fabricated by metal assisted chemical etching method”, *IEEE-MEMS 2018*, 1253-1256.
(2) N.V. Toan, N. Inomata, M. Toda and T. Ono, “Ion transport by gating voltage to nanopores produced via metal-assisted chemical etching method”, *Nanotechnology*, 195301, 2018.

6. 関連特許（Patent）

なし