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利用課題名(日本語) :
Program Title (English) :Plasmonic nanochannel structure for sensing application
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1. 概要(Summary)

We report a plasmonic nanochannel structure consisting of gold (Au) U-shaped cavities separated by nanochannels (Si). This nanochannel structure sustains strong and tunable absorption resonances with narrow bandwidths generated from the coupling of surface plasmons in the channels and on the bottoms. Due to the effective light confinement and strong absorption, the nanochannel structure is promising for sensing applications.

2. 実験(Experimental)

【利用した主な装置】

高速大面積電子線描画装置(ADVANTEST F5112+VD01)、高速シリコン深掘りエッチング装置(SPTS MUC-21 ASE-Pegasus)、電子顕微鏡(Hitachi S-4700)

【実験方法】

The plasmonic nanochannel structure was fabricated as following steps. A SOI substrate (chip size of 4 cm^2) with 700 nm top layer (Si), 3 μm buried oxide layer (SiO_2), and 525 μm handle layer (Si) was first cleaned by acetone and ethanol. An electron beam resist (ZEP520A, Zeon Corporation, Tokyo, Japan) was spin coated on the substrate. A lithography process was performed with an electron beam lithography system (F5112+VD01, Advantest, Tokyo, Japan) to form a line-and-space resist pattern. Then, the top Si layer was etched by inductively coupled plasma etching system (SPTS MUC-21 ASE-Pegasus, Sumitomo Precision Products Co., Ltd., Amagasaki, Japan) as shown in images (Fig. 1) from scanning electron microscope (SEM) (Hitachi S-4700). After the etching process, a conformal Au layer was sputtered on the resist pattern using DC sputtering in a rotating angle of 45° with respect to the plane of the substrate. Finally, the resist with the Au layer on the tops is removed by lift-off.

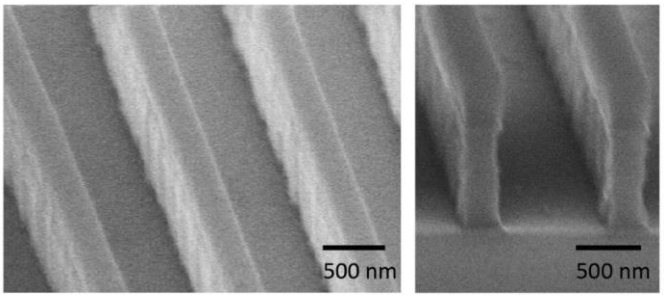

Fig. 1 SEM image of the nanochannel structure

3. 結果と考察(Results and Discussion)

Optical properties of the fabricated nanochannel structure are measured for the reflection spectrum by FT-IR spectrometer. A sharp and strong reflectance dip is observed at about 1600 nm in the near-infrared (NIR) region with narrow bandwidth about 30 nm and reflectance modulation larger than 0.5 (50 %). This sharp resonance could be used for chemical and biological sensing applications in the NIR region.

4. その他・特記事項(Others)

This work was supported through JSPS KAKENHI Grant Numbers (26289013, 15F15359) and JSPS Core-to-Core Program (Advanced Research Networks type A).

5. 論文・学会発表(Publication/Presentation)

(1) S. Yin, Z. Wang, Y.-L. Ho, and J.-J. Delaunay, IEEE NANO 2016 (2016) (Submitted).

6. 関連特許(Patent)

なし。