課題番号 :F-16-UT-0011
利用形態 :機器利用
利用課題名(日本語) :
Program Title (English) :Plasmonic nanochannel photodetector with spectral-selectivity
利用者名(日本語) :王 智宇、クラーク ジョン健志、黄 立中、何 亜倫、ジャンジャック・ドロネー
Username (English) :Z. Wang, J. K. Clark, L.-C. Huang, Y.-L. Ho, J.-J. Delaunay
所属名(日本語) :東京大学大学院工学系研究科
Affiliation (English) :School of Engineering, The University of Tokyo

1. 概要(Summary)

The optical response of subwavelength plasmonic structures can be used to monitor minute changes in their physical, chemical, and biological environments with high performance for sensing. Here, we report on an electronically readable photocapacitor based on a plasmonic nanochannel structure with high spectral resolution and a large modulation capability. The structure consists of metallic U-cavities and semiconductor channels, which are used to focus and confine light at the semiconductor−metal interfaces. The capacitance modulation of the structure in response to light produces a light-to-dark contrast ratio larger than 1000. A reflectance spectrum with a bandwidth of 16 nm and a 6% modulation depth is detected using a reactance variation of 3 kΩ with the same bandwidth. This photocapacitor design offers a practical means of monitoring changes induced by the near field and thus could be deployed in pixel arrays of image sensors for miniaturized spectroscopic 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

形状・膜厚・電気評価装置群 Keyence, Laser microscope, DektakXT-S, NanoSpec, Suss8"プローバ

電子顕微鏡 Hitachi S-4700

【実験方法】

The nanochannel structure was fabricated using the following steps. An SOI substrate with a 700 nm (± 50 nm) device layer (Si), a 3 µm buried oxide layer (SiO_2), and a 525 µm handle layer (Si) or a Si substrate with a thickness of 525 µm were cleaned, and an electron beam resist (ZEP520A, Zeon Corporation, Tokyo, Japan) was spin coated on the substrates. A lithography process was performed with an electron beam lithography system (F5112, Advantest, Tokyo, Japan) to form a line-and-space resist pattern. Then, the Si was etched by inductively coupled plasma etching system (MUC21, Sumitomo Precision Products Co., Ltd., Amagasaki, Japan). After the etching process, a conformal Au layer was sputtered on the resist pattern by DC sputtering using a sample stage rotating at an angle of 45° with respect to the Au target. Finally, the resist together with its Au top layer is removed by lift-off in an ultrasonic bath.

3. 結果と考察(Results and Discussion)

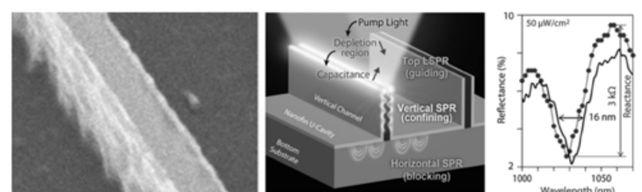

Fig. 1 SEM images of fabricated nanochannel structures with a channel width of 380 nm (left). Illustration, reflectance spectrum and reactance variation of plasmonic nanochannel structure (right).

4. その他・特記事項(Others)

This work was supported through Japan Society for the Promotion of Science (JSPS) KAKENHI Grant Numbers (26289013, 15F15359)

5. 論文・学会発表(Publication/Presentation)

(1) Y.-L. Ho, L.-C. Huang, and J.-J. Delaunay, Nano Lett., Vol 16, (2016) 3094

6. 関連特許(Patent)

なし