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利用形態　:共同研究
利用課題名（日本語）　:
Program Title (English)　:Aluminum nanostructured plasmonic sensors using capped dielectric layers
利用者名（日本語）　:
Username (English)　:Kuang-Li Lee
所属名（日本語）　:
Affiliation (English)　:Research Center for Applied Sciences, Academia Sinica
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## 1. 概要（Summary）

Aluminum nanostructures have received considerable attention as a plasmonic sensor because aluminum is a cost-effective plasmonic material. However, the intrinsic properties of the aluminum with a large imaginary part of the dielectric constant, a longer electromagnetic field decay length as well as problems of poor long-term chemical stability, restrict the surface-sensing capability and applicability.[1] We are collaborating with Prof. Misawa's group at Hokkaido University and recently proposed a combination of capped aluminum nanoslits and a thin-capped dielectric layer to overcome these drawbacks. We explored influences of the dielectric layer for the wavelength sensitivities of the Wood's anomaly-dominant resonance and asymmetric Fano resonance in capped aluminum nanoslits.

## 2. 実験（Experimental）

【利用した主な装置】

Ultra-high precision electron-beam lithography system, ELS-F125 (Elionix)

【実験方法】

Periodic nanogrooves in a 100 nm-thick diluted ZEP-520 resist (Zeon Co.) were patterned on a silicon substrate using an electron-beam lithography system. The width, depth, and period of the periodic nanogrooves were 60, 100, and 470 nm, respectively. The patterns were deposited on a thin gold film and then electroformed with Ni and Co to fabricate a metal mold. The template was used to replicate the nanostructures on the plastic film using homemade hot embossing nanoimprint equipment.

## 3. 結果と考察（Results and Discussion）

It was clarified that the dielectric layer can positively enhance the wavelength sensitivities of the sensor in capped aluminum nanoslits. The maximum improvement can be reached by a factor of 3.5. Besides, there is an optimal layer thickness for the surface sensitivity because of the trade-off relationship between the refractive index sensitivity and decay length as shown in Figure 1. We attribute the enhanced surface sensitivity to a reduced evanescent length.

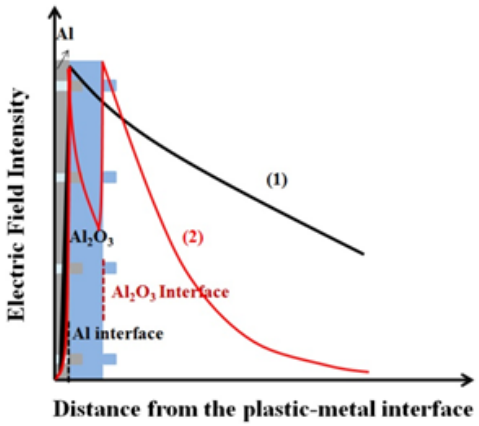


**Figure 1.** A schematic diagram of the electric-field distributions at metal and alumina interfaces for aluminum-capped nanoslits and alumina/aluminum-capped nanoslits.

## 4. その他・特記事項（Others）

参考文献

1. K. L. Lee et al. *Sci. Rep.* **2017**, *7*, 44104.

共同研究者：X. Shi, K. Ueno, H. Misawa, P.-K. Wei、.

## 5. 論文・学会発表（Publication/Presentation）

1. K.-L. Lee et al. *ACS Omega* **2017**, *2*, 7461-7470.

6. 関連特許(Patent)

なし