Supplementary Information

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1. Comparison of the propagation length and evanescent depth of surface plasmon wave on aluminum and gold films

For the surface plasmon polariton (SPP) propagating along the metal/dielectric interface, the propagation constant *β*, can be calculated by [1]

$$\beta \cong \frac{\omega}{c}\sqrt{\frac{n^2\varepsilon_{m1}}{n^2+\varepsilon_{m1}}} + i\frac{\omega}{c}\left(\sqrt{\frac{n^2\varepsilon_{m1}}{n^2+\varepsilon_{m1}}}\right)^3\left(\frac{\varepsilon_{m2}}{2\varepsilon_{m1}{}^2}\right) = \beta_1 + i\beta_2$$

Where ε_{m1} is real part and ε_{m2} is the imaginary part of the dielectric constant of the metal. The propagation length along the propagation direction (x-axis) could be estimated as $L_x = (2\beta_2)^{-1}$. On the other hand, the evanescent depth (*d*) of the surface plasmon wave can be estimated by $d = Im[\frac{\lambda}{2\pi}(\frac{n^2+\varepsilon_m}{n^4})^{1/2}]$. Some research had calculated the L_x, *d* and compared both with different metal thin film (references 31, 32 in the article). The aluminum film has a larger ε_{m2} than the gold film. It is expected to have a short propagation length. However, aluminum also has a larger ε_{m1} than the gold. It turns out that the propagation lengths of SPP wave on aluminum film is similar to that of the gold film. For example, the dielectric constant is -57.054+24.032i for aluminum and -12.953+1.1209i for gold at 650 nm wavelength. Based on above equations, the L_x is about 13.6 μm for aluminum and 13.7 μm for gold. On the other hand, the calculated evanescent depth at 650 nm wavelength is about 100 nm for gold and 302 nm for aluminum. The shorter evanescent field of the SPP wave on gold film results in a larger scattering loss by the 90-nm-height metallic caps. Due to the high scattering loss, the resonant quality of BW-SPP on the gold capped nanoslit array is low. The transmission dip in the Fano resonance comes from the BW-SPP. Therefore, the dip in the gold capped nanostructure is not obvious.

[1] Homola, J., Electromagnetic Theory of Surface Plasmons. In *Surface Plasmon Resonance Based Sensors*, Homola, J., Ed. Springer Berlin Heidelberg: Berlin,

Heidelberg, 2006; pp 3-44.

2. Optimal parameters for aluminum capped nanoslit array

The structure parameters for the metal capped nanoslit arrays are the period, slit width, slit depth and thickness of the metal as shown in Fig. 1(b). For a typical gold-based SPR device, the gold film thickness is around 50 nm. To have a comparison with the gold-based SPR, we have fixed the metallic thickness about 45 nm in the FDTD simulations. The optimal period as indicated in Fig. 2(f) is about 470nm. The slit width and height also influence the resonance and the sensitivity. We have applied FDTD simulations to show their effects on the resonance and sensitivity. The following figures show the FDTD calculated transmission spectra and thickness sensitivities as a function of the slit width (Fig. S1) and slit depth (Fig. S2). Based on the simulation results, the optimal conditions of the aluminum capped nanoslit array are about 90-nm slit width, 70-nm slit thickness with 470-nm period. We fabricated aluminum capped nanoslit arrays using the similar structure parameters.

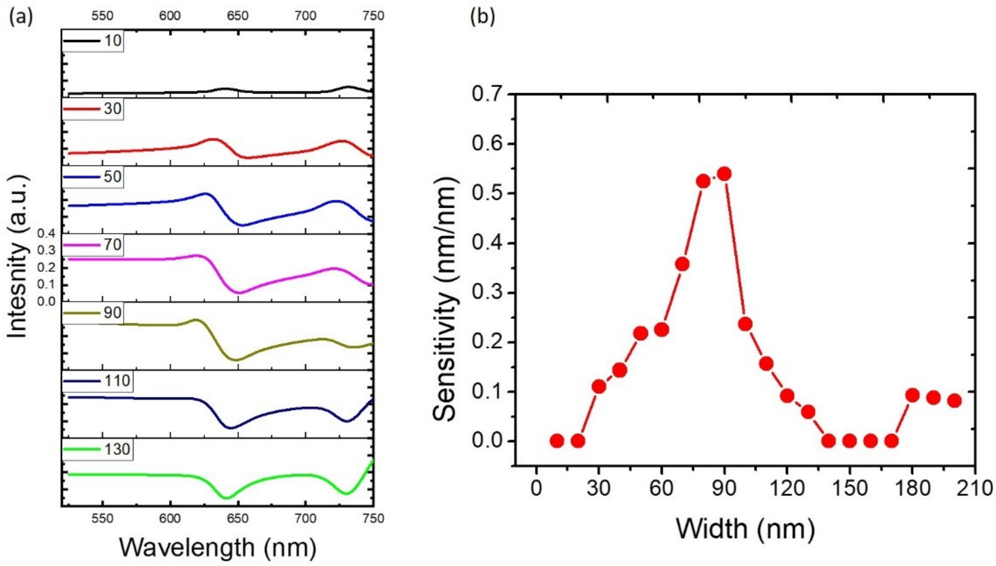

Figure S1. (a) The calculated transmission spectra and (b) thickness sensitivities as a function of the slit width. In the FDTD calculation, the slit width was changed from 10 nm to 200 nm. The period (470 nm), the slit depth (70 nm) and the aluminum film thickness (45 nm) were fixed. The spectra show that only slit width below 90 nm has a sharp Fano resonance, a clear peak followed by a clear dip. The slit width has a maximum surface sensitivity around 90 nm.

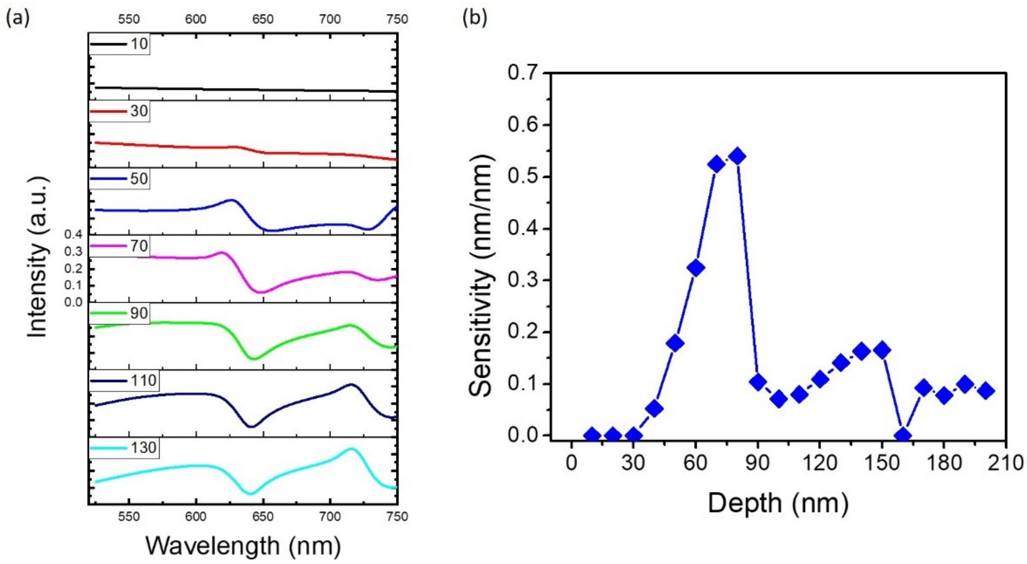

Figure S2. (a) The calculated transmission spectra and (b) thickness sensitivities as a function of the slit depth. In the FDTD calculation, the slit depth was changed from 10 nm to 200 nm. The period (470 nm), the slit width (90 nm) and the aluminum film thickness (45 nm) were fixed. The Fano spectra show a clear peak followed by a clear dip when the slit depth falls between 30 nm and 90 nm. The slit depth has a maximum surface sensitivity around 70nm.

3. The fabrication of metal capped nanoslit arrays

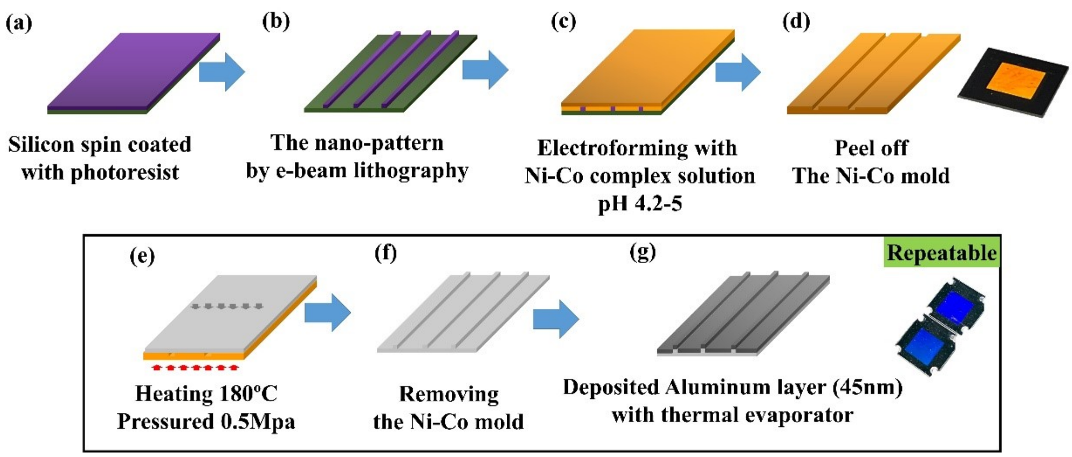

Figure S3. The flow chart for the fabrication of metal capped nanoslit array. (a)-(d) The fabrication of Ni-Co nanoslit array as the mold for the nanoimprinting process. (e)-(g) The transfer of the nanoslit array pattern on the mold to the plastic substrate using plastic nanoimprinting method and the coating of metallic film on the nanoimprinted surface. The detailed processes are as followings:

a. A 100 nm-thick diluted ZEP-520 resist (ZEP-520, Zeon Corp, Tokyo, Japan) was spin-coated onto a 525 μm-thick silicon substrate.

b. An electron-beam writing system (Elionix ELS 7000) was used to pattern groove arrays

c. Electroforming with Ni-Co complex solution pH 4.2-5 to produce a 250 μm thick metal mold. The Ni–Co mold was supported by Hui Fong Micro-Fabrication Technologies Co., Ltd.

d. Peel off the Ni-Co mold and electric welding on the metal holder to make nano-imprint stamp.

e. The PC thin film is covered on the Ni-Co mold and hot embossing with Heating 180ºC Pressured 0.5Mpa for couple minutes and wait to cold down room temperature.

f. After cooling the remove the Ni-Co mold which could be re-fabricated the nanostctures form mold to PC film.

g. The PC film with nanostructure is deposited aluminum layer (45nm)
with thermal evaporator.

In general, the step from e to g is repeated for fabrication of SPR chips then do experiments and without complicate process from step a to step d.

4. The stability test of aluminum capped nanoslit arrays with 5-nm Al_2O_3 protective layer under water environment.

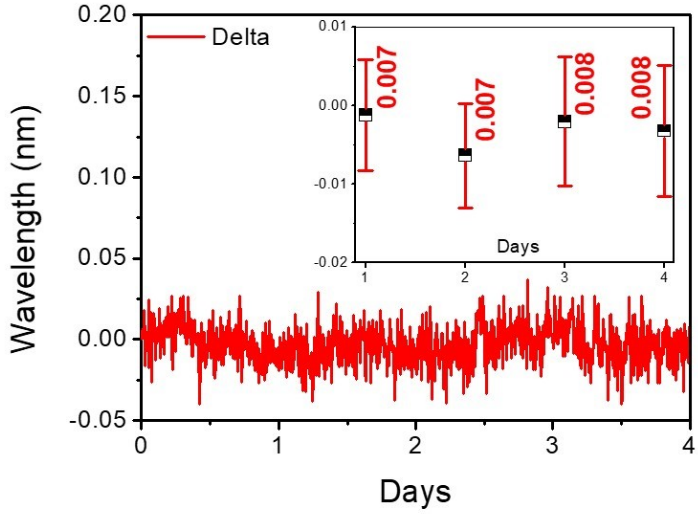

Figure S4. The measured wavelength variation for the peak wavelength of the Fano resonance. The aluminum capped nanoslit chip was placed in the fluidic channel for 4 days. The signals are very stable. With a variation within 0.0075 nm. Each signal is continually acquired with 5-minutes interval.