Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Highly controllable double Fano resonances in plasmonic metasurfaces

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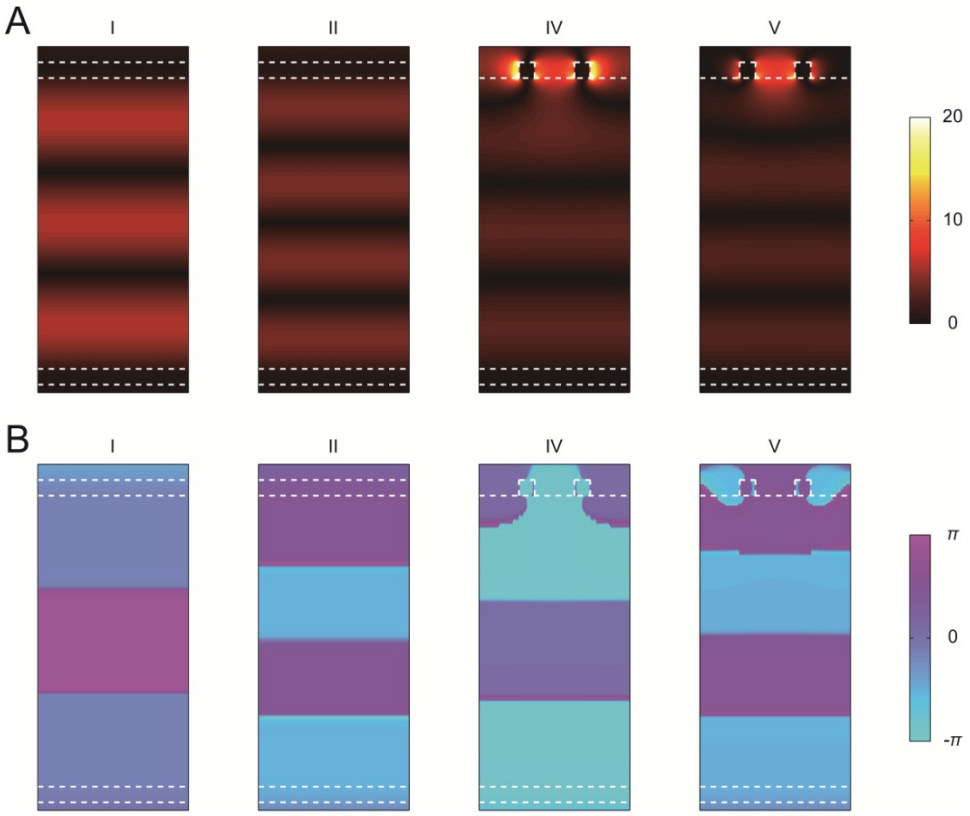

Figure S1. (**A**) The electric field ($\mathbf{E_x}$) and (B) the phase maps of mode **I**, **II**, **IV** and **V**. The white dashed lines show the doundaries between different media.

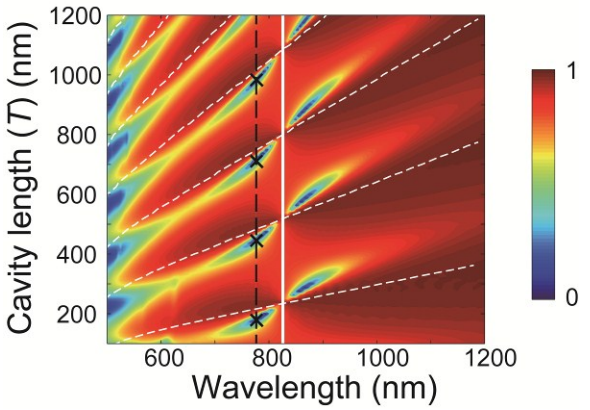

Figure S2. Reflection maps of NSAF (*P* = 380 nm, *h* = t_2 = 50 nm, d_1 = 180 nm, d_2 = 100 nm) when the cavity length (*T*) is adjusted from 100 to 1200, which is the reproduce of the graph in **Figure 3B Middle**. The black line locates at 785 nm. The symbols of asterisk mark the NSAF with resonance at 785 nm.

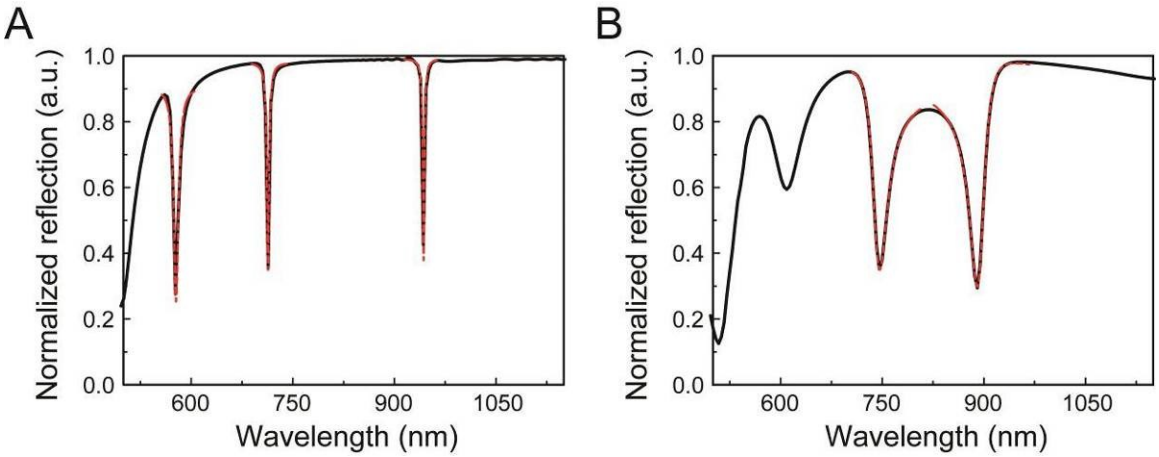

Figure S3. Dip fittings by (**A**) Lorentz fitting and (**B**) Fano fitting for AC (*T* = 925 nm, t_1 = t_2 = 50 nm) and NSAF (*P* = 380 nm, *T* = 925 nm, d_1 = 180 nm, d_2 = 100 nm, *h* = t_2 = 50 nm). The raw data are illustrated by black solid lines and the fitting data are presented by red dashed lines.

As for the Fano resonances in NSAF, their asymmetric line shapes in the reflection spectra is describe by $R(\omega) = |r(\omega)|^2$ with

$$r(\omega) = a + \frac{b\Gamma e^{i\phi}}{\omega - \omega_0 + i(\gamma + \Gamma)}. \qquad \text{* MERGEFORMAT (S1)}$$

Here *a* is the amplitude of the constant background, and *b* and ϕ characterize the amplitude and the phase of the Fano resonance. The angular frequency ω_0 correspond to the resonance frequency. The nonradiative damping γ and the radiative damping Γ contribute to the resonance width. The FWHM of the Fano resonance is calculated by $\Delta E = \hbar\Delta\omega = \hbar(\gamma + \Gamma)$. The Fano model cannot well fit the whole spectra with the symmetric and asymmetric resonances. With this consideration, we applied spectral fitting only in the resonance regimes, hence the fitting curve is not a continuous line. To obtain a comparable FWHM, the Lorentz fitting is applied in a similar manner to the resonances in NA and AC structures.

To compare with the FWHM of NA and cavity fitted by Lorentz formula, the FWHM expressed by energy is converted to wavelength through

$$\Delta\lambda = 2\pi c(\frac{1}{\omega_0 - \Delta\omega/2} - \frac{1}{\omega_0 + \Delta\omega/2}), \qquad \text{* MERGEFORMAT (S2)}$$

where *c* is the light speed.