Electronic Supplementary Information (Experimental Methods, supporting figure S1-S4)

Structural Coloration of Transmission Light through Self-Aligned and Complementary Plasmonic Nanostructures

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EXPERIMENTAL METHOD

Numerical modeling: Three-dimensional FDTD calculations were performed for complementary plasmonic structures (CPS) by using Lumerical FDTD solutions (ver. 8.17.1157). The material index for substrate and HSQ nanopillars was given by SiO_2 (glass) derived from Palik. The dielectric permittivity model of Ag (Silver) for nanohole and nanodisks was derived from Palik as well. Normal plane light source wave was chosen, propagating along the z-axis. The mesh size was less than 5 nm for high precision. For periodic CPS structures, boundary condition was set with 'Bloch' along the x-axis (i.e. orthogonal to k-vector and parallel to E-field of source), 'Symmetric' along the y-axis (i.e. orthogonal to k-vector and orthogonal to E-field of source), and 'PML (Perfect Matched Layer)' along the z-axis.

SUPPLEMENTARY FIGURES (Fig. S1-S4)

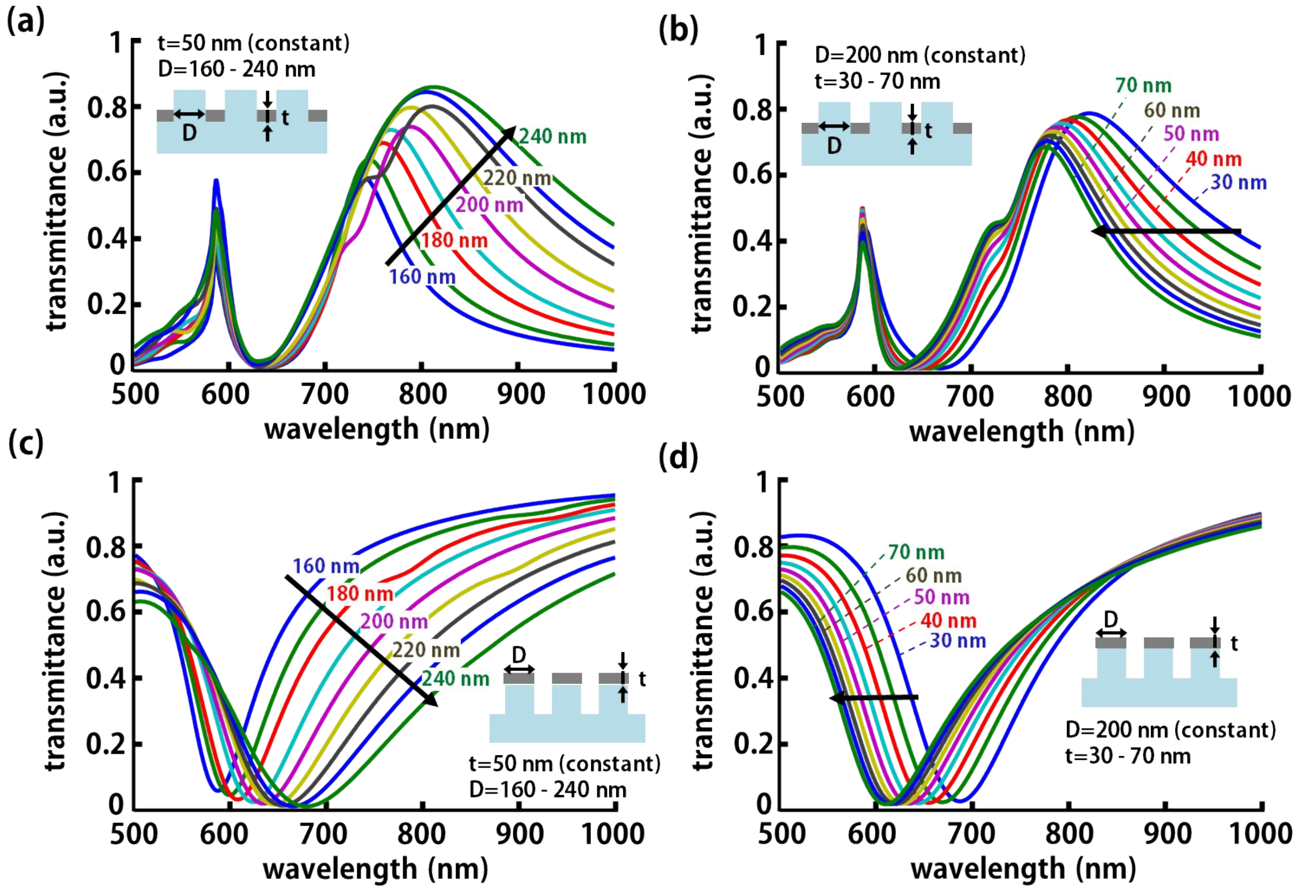

Figure S1. FDTD calculation of nanohole arrays (NHA) and nanodisk arrays (NDA), depending on disk/hole diameter and silver thickness. (a) Transmission spectra of the NHA as the hole diameter is increased from 160 nm to 240 nm under a constant Ag thickness of 50 nm. (b) Transmission spectra of the NHA as the Ag thickness is increased from 30 nm to 70 nm under a constant hole diameter of 200 nm. (c) Transmission spectra of the NDA as the disk diameter is increased from 160 nm to 240 nm under a constant disk thickness of 50 nm. (d) Transmission spectra of the NDA as the disk thickness is increased from 30 nm to 70 nm under a constant disk diameter of 200 nm. The periods of NHA and NDA are set to 400 nm for all the calculation. Both the diameter and the thickness are increased by 10 nm and 5 nm, respectively.

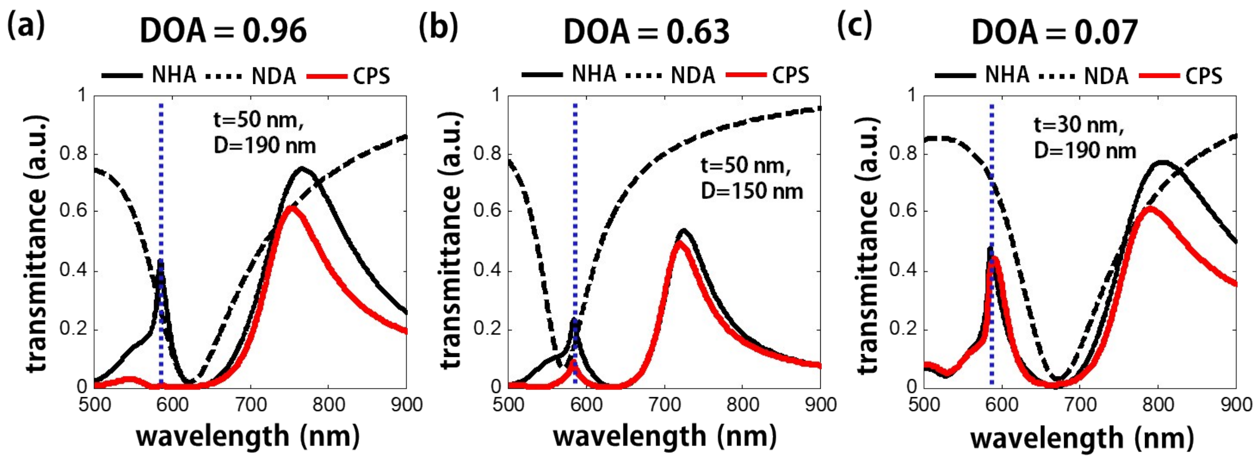

Figure S2. Calculated transmission spectra of NHA, NDA, and complementary plasmonic structures (CPS) with specific structural dimension of different degree-of-attenuation (DOA). (a) The second-order spectral peak of NHA is strikingly attenuated when Ag thickness and hole/disk diameter is 50 nm and 190 nm, respectively. Blue dotted line in each figure indicates the wavelength of second-order spectral peak of NHA. (b) The second-order spectral peak of NHA is adequately attenuated, exhibiting DOA of 0.63. The extinction dip of NDA is blue-shifted in comparison of (a). (c) The CPS show the lowest DOA for the Ag thickness of 30 nm and the disk/hole diameter of 190 nm. The extinction dip of NDA is apart from the second-order spectral peak of NHA.

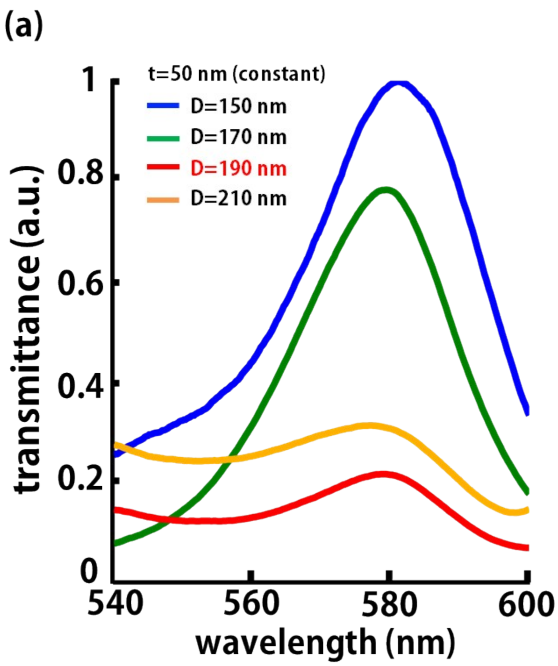

Figure S3. Measured transmittance of the second-order spectral peak from CPS as (a) the disk/hole diameter is varied from 150 nm to 210 nm and (b) the Ag thickness is varied from 30 nm to 60 nm, respectively. The second-order spectral peak is highly attenuated (i.e. low transmittance) when the disk/hole diameter and the Ag thickness are 190 nm and 50 nm, respectively.

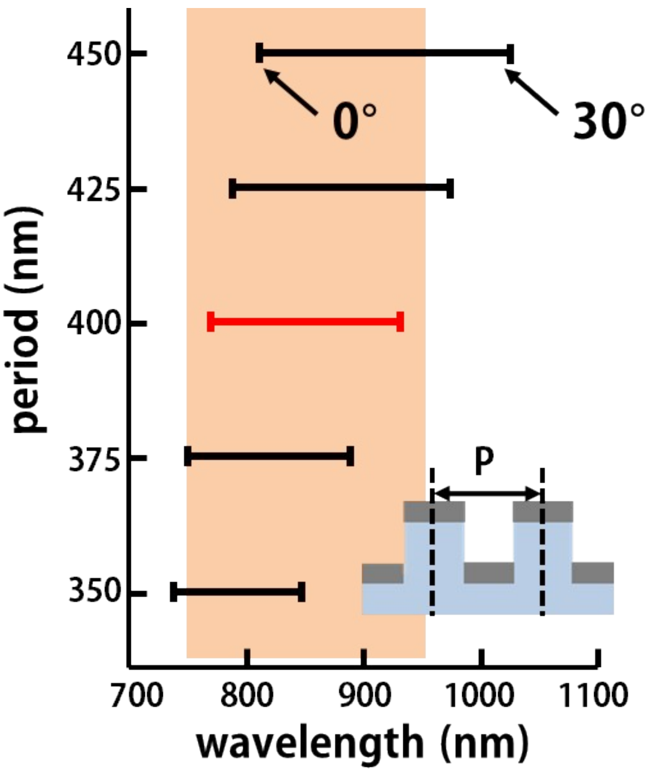

Figure S4. FDTD calculation for tuning range of CPS depending on the period. The disk/hole diameters and the Ag thickness are constant at 190 nm and 50 nm, respectively. Depending on the incident angle of 0° and 30°, the tuning range of CPS, i.e., the length of each solid line, becomes red-shifted and increased as the period increases from 350 nm to 450 nm.