SUPPORTING INFORMATION

Gigahertz optomechanical modulation by split-ring-resonator nanophotonic meta-atom arrays

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OPTICAL 3D FINITE-ELEMENT MODELLING

The optical reflectance, transmittance and absorption spectra of the sample for normal incidence are simulated with a frequency-domain finite-element method (COMSOL Multiphysics) to solve the Maxwell equations. The unit cell consists of a BK7 glass substrate, a gold split-ring resonator (SRR) and the vacuum above them, as shown in Fig. S1. The SRR dimensions chosen, with reference to Fig. 1(a) of the main text, are side l=230 nm, gap d=84 nm, bottom-width w=92 nm and thickness t=60 nm. We implement periodic boundary conditions (BCs) with an unit cell of a gold SRR set on the interface between the vacuum and the BK7 glass substrate. S-parameter ports are used over two parallel planes, termed the input and output planes, defined to be 400 nm from this interface, and optical scattering BCs, set 100 nm outside these ports, are also used, as shown in Fig. S1. A total of approximately 1,150,000 tetrahedral mesh elements are used for the discretization, of maximum side 63 nm in the vacuum, maximum 42 nm in the BK7 substrate and maximum 15 nm in the gold SRR. (These mesh sizes are six times smaller than the minimum simulated optical wavelength in each medium.) A finer mesh was used near the corners in the gold SRR, where the electric fields are particularly enhanced. The refractive indices of gold and BK7 glass are taken from the literature[1,2]

Simulations were performed independently with electric field **E** polarized along the x axis (horizontal polarization) and with **E** polarized along the y axis (vertical polarization). The simulated reflectance, transmittance, and absorption for the two polarizations are plotted in Fig. 2(a) and (b) of the main text, respectively. Vector **E**-field and current density **J** plots on the top surface of an SRR at the optical wavelengths corresponding to the three peaks identified in Fig. 2(a) and (b) of the main text are shown in Fig. S2.

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[1] http://www.schott.com/d/advanced_optics/ac85c64c-60a0-4113-a9df-23ee1be20428/1.1/schott-optical-glass-collection-datasheets-english-17012017.pdf.

[2] Hagemann, H.-J., Gudat, W. & Kunz, C. *J. Opt. Soc. Am.* **65**, 742–744 (1975).

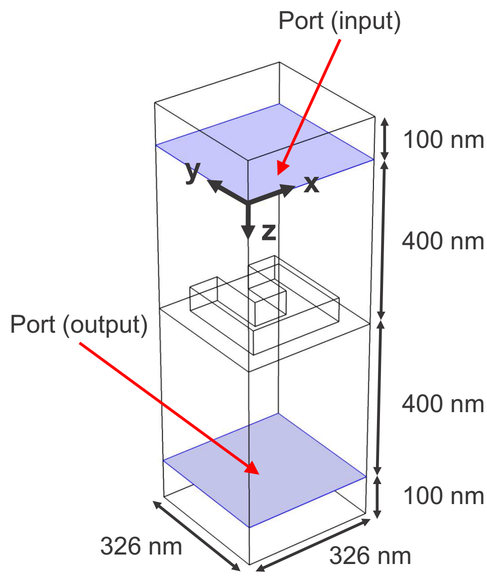

FIG. S1. Geometry of the SRR unit-cell structure used for electromagnetic simulations

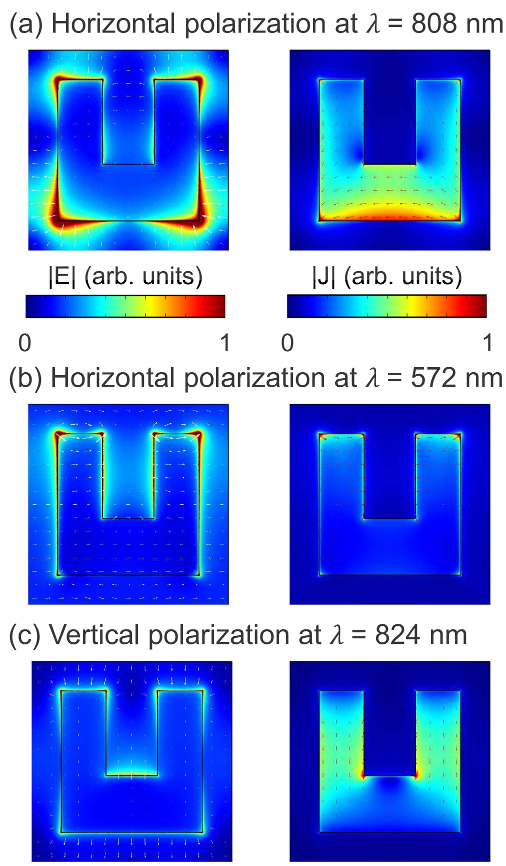

FIG. S2. Vector **E**-field (left) and current density **J** (right) plots for optical wavelengths corresponding to (a) peak (1), (b) peak (2) in Fig. 2(a) of the main text, and (c) at the peak of wavelength 824 nm in Fig. 2(b) of the main text.