Supplementary Material

Supplementary note 1. Analysis of chiral enhancement with to the control of the changes of height in squared nanoblocks.

Figure S1a demonstrates calculated chiral enhancement (C enhancement, $-C/C_0$) of silicon (Si) nanoblock based on the numerical simulations. We control the simulation parameters to find the relationship between resonance and chirality as the height of nanoblock varies. The width and length of nanoblocks are fixed to be 125 nm. The trend and the values of chirality in Figure S1a and Figure 1d imply that when a structure has a rotation symmetry, a high level of C enhancement can be obtained. For structures with rotation symmetry, the identical response is given to each orthogonal polarization. The designed structure shows the high C enhancement due to the overlap of electrical dipole (ED) and magnetic dipole (MD) for the incident light with orthogonal polarizations.

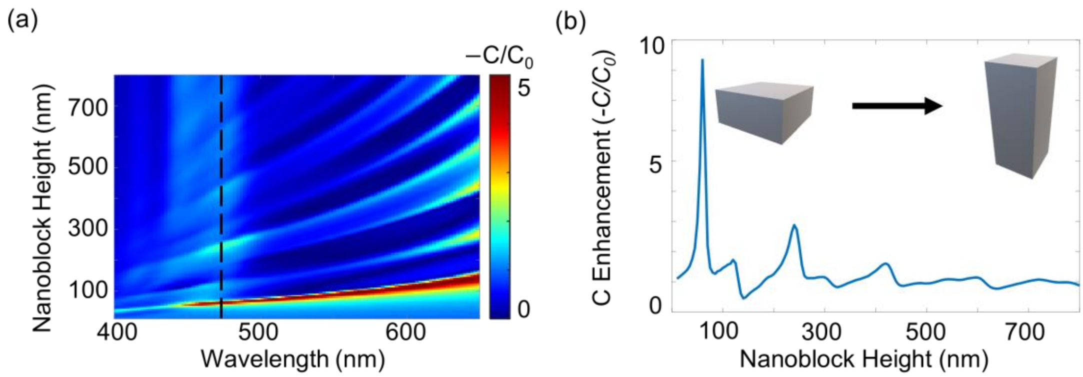

Figure S1. (a) Calculated C enhancement of silicon (Si) nanostructures for the continuously tuned height of the nanostructure. **(b)** C enhancement with respect to the heights at the resonance wavelength of 470 nm indicated as the black dotted line in (a).

Supplementary note 2. Analysis of chiral enhancement with the control of the changes of width in nanostructures.

We confirmed the C enhancement by changing the length of nanobeam with different widths and fixed height of 60nm. We analyzed the results by varying the width of the nanobeam structures from 95 to 245 nm, which shows that the structures we designed are optimized for enhancement in the target wavelength of 470 nm.

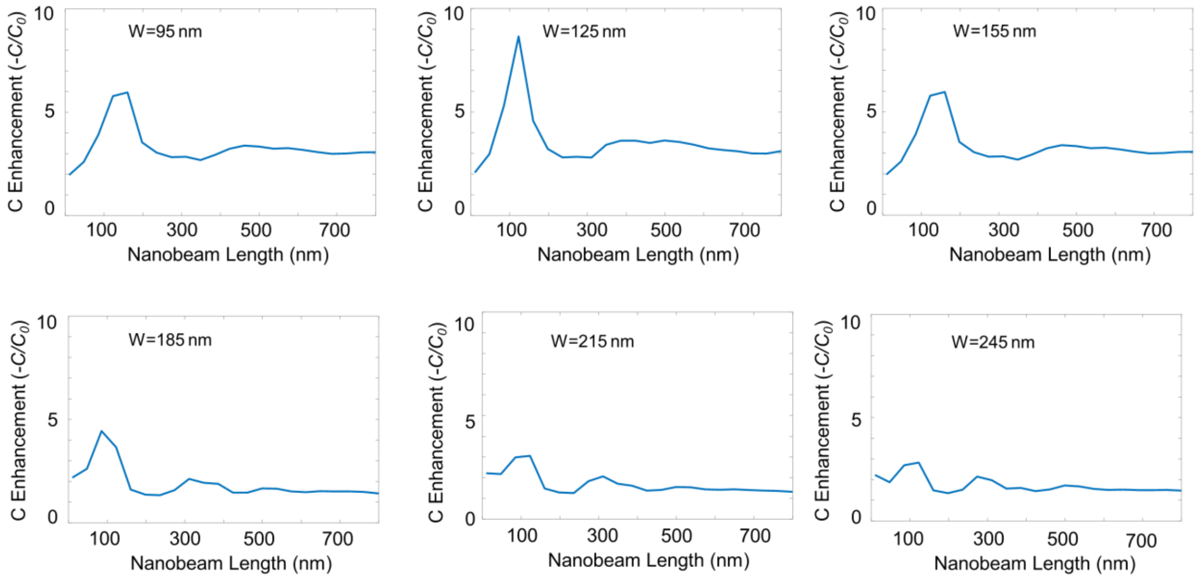

Figure S2. C enhancement by changing the length of nanobeam with different widths at the resonance wavelength of 470 nm.

Supplementary note 3. Theoretically calculation of Q_{sca} based on t he analysis of dipole decomposition

We theoretically analyzed the scattering crosssection based on Mie coefficients as follows [1]:

$$a_n = \frac{m^2 j_n(mx)[xj_n(x)]' - \mu_1 j_n(x)[mxj_n(mx)]'}{m^2 j_n(mx)\left[xh_n^{(1)}(x)\right]' - \mu_1 h_n^{(1)}(x)[mxj_n(mx)]'} \tag{1}$$

$$b_n = \frac{\mu_1 j_n(mx)[xj_n(x)]' - j_n(x)[mxj_n(mx)]'}{\mu_1 j_n(mx)\left[xh_n^{(1)}(x)\right]' - h_n^{(1)}(x)[mxj_n(mx)]'} \tag{2}$$

where a_n and b_n are the electric and magnetic coefficients, respectively and x, ε_1, μ_1 are the size parameter, permittivity, permeability of the particle, respectively. j_n and $h_n^{(1)}$ denote the spherical Bessel, Hankel function. The total scattering crosssection (C_{sca}) can be defined with Mie coefficients [1–3]:

$$C_{sca} = \frac{2\pi}{k^2} \sum_n^{\infty} (2n+1)(|a_n|^2 + |b_n|^2) \tag{3}$$

where k is the wavenumber. When n equals 1, it means scattering for values in ED (a_1), MD (b_1). Based on the equation (3), the scattering efficiency generated by the designed structure was analyzed. Figure S3 demonstrates theoretically calculated and numerically simulated scattering efficiency (Q_{sca}) as the length Si nanostructure changes with the height and width fixed to be 60 nm and 125 nm, respectively. When the width and length of the structure were equal (L=125 nm), ED and MD resonances occur at approximately the same wavelength. It is noteworthy that the magnitude of total scattering is large and the phases between ED and MD resonances are close to be equal. Through the theoretical decomposition of scattering, we have confirmed that the two dipole modes closely match with the simulated analysis.

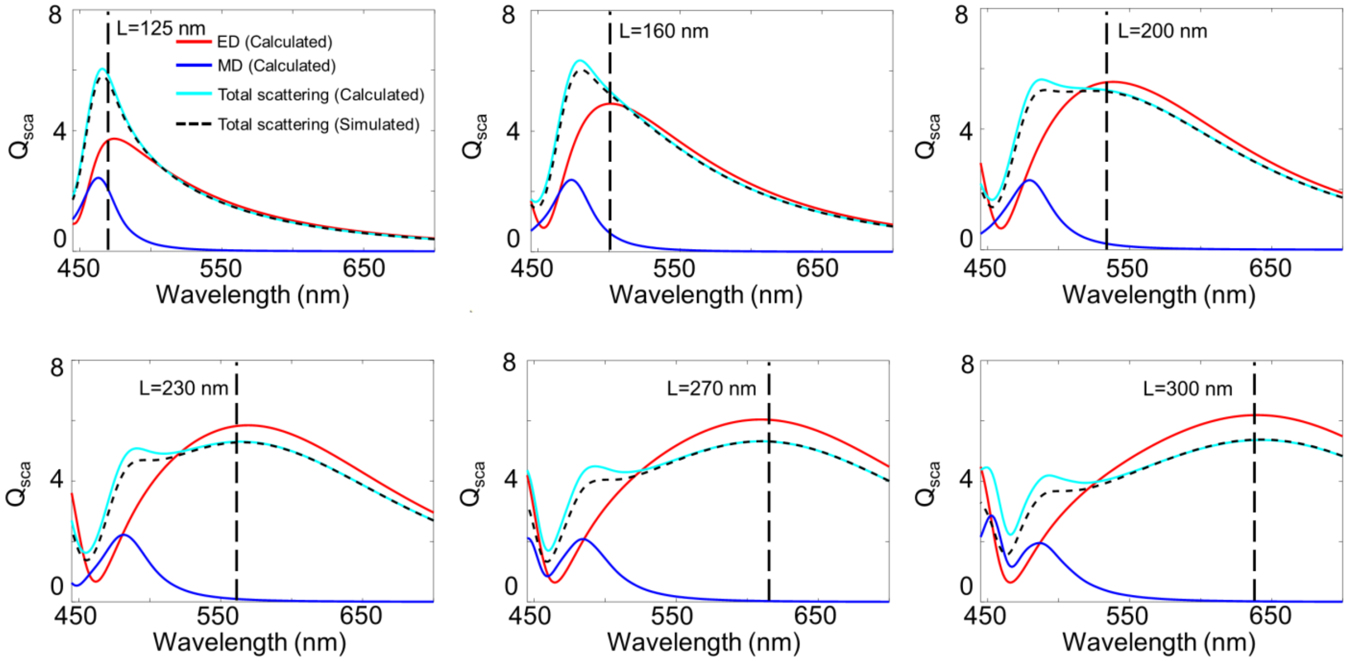

Figure S3. Spectrums of theoretically calculated and numerically simulated Q_{sca} as the length (L) of nanobeam is tuned from 95 to 300 nm. Theoretically calculated electric dipole (Red line). Theoretically calculated magnetic dipole (Blue line). Theoretically calculated total scattering (Cyan line). Numerically simulated total scattering (Black dotted line). Vertically black dotted line indicated the ED resonance point.

Supplementary note 4. Scattering efficiency and C enhancement for various sizes and shapes of nanostructures.

Figure S4a shows numerically simulated map of the scattering efficiency (Q_{sca}) of Si nanostructures with the incident light of right-handed circularly polarization. The nanostructure is designed as elliptical shape with the end faces of the nanobeam structure being designed as round. As the length gradually decreases, the shape approaches to cylindrical shape. Figure S4b shows that a high level of optical chirality is obtained when the nanostructure features rotation symmetry which induces the overlap of ED and MD resonances. Figure S4c and Figure S4d are numerically simulated map of Q_{sca}, calculated C enhancement of circular post nanostructure. These results show that the structure presented in the manuscript is optimized for achieving high C enhancement at target wavelength near 450 nm.

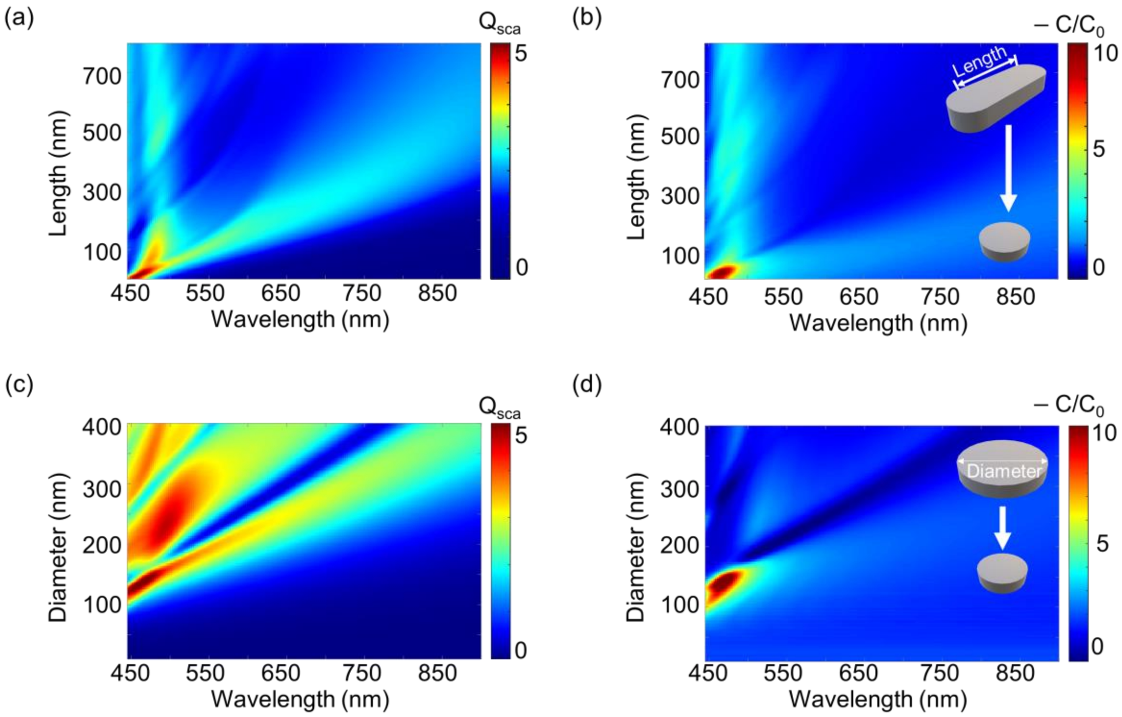

Figure S4. (a) Numerically simulated Q_{sca} of Si nanostructures for the continuously tuned length of the elliptical nanostructures. **(b)** Calculated C enhancement of Si nanostructures in (a). **(c)** Numerically simulated Q_{sca} of Si nanostructures for the continuously tune diameter of the circular post nanostructures. **(d)** Calculated C enhancement of Si nanostructures in (c).

Supplementary Material References

1. Bohren, C.F; Huffman, D.R. *Absorption and Scattering of Light by Small Particles*; John Wiley & Sons: Hoboken, NJ, USA, 2007.
2. Shore, R.A. Scattering of an Electromagnetic Linearly Polarized Plane Wave by a Multilayered Sphere: Obtaining a computational form of Mie coefficients for the scattered field. *IEEE Antennas Propag. Mag.* **2015**, *57*, 69–116, doi:10.1109/MAP.2015.2453885.
3. Kerker, M. *The scattering of Light and Other Electromagnetic Radiation: Physical Chemistry: Aseries of Monographs*; Academic Press: Cambridge, MA, USA, 2013.