Supporting Information

High-Q chiral metasurface with quasi-BIC for tunable circular dichroism and refractive index sensing

Zongli Hu,[a] Wei Su,*[b] Jialing Shi,[a] and Bin Tang*[a]

[a].*School of Microelectronics, Changzhou University, Changzhou, 213164, China. E-mail: btang@cczu.edu.cn*

[b].*College of Mechanics and Engineering Science, Hohai University, Nanjing, 211100, China. E-mail: opticsu@hhu.edu.cn*

Section 1. The dispersion relation of Si and SiO_2 in the near-infrared band

Fig. S1 shows the complex refractive index of Si and SiO_2 in the near-infrared band based on the experimental data [1]. As shown in the provided datasets, both materials exhibit extremely weak dispersion and negligible absorption in this spectral region: the real part $n(\lambda)$ of Si remains around 3.48 with an imaginary part $k(\lambda)$ close to zero, while SiO_2 maintains a real part near 1.45 with a vanishingly small imaginary component. Specifically, at the wavelength near 1420 nm, the real (imaginary) parts of the refractive index for Si and SiO2 are 3.489 (4.26771×10^{-9}) and 1.446 (3.53333×10^{-7}), respectively. Therefore, performing simulations with full complex refractive indices yields negligible differences compared to using constant refractive indices, and the Q-factor and CD responses remain essentially unchanged.

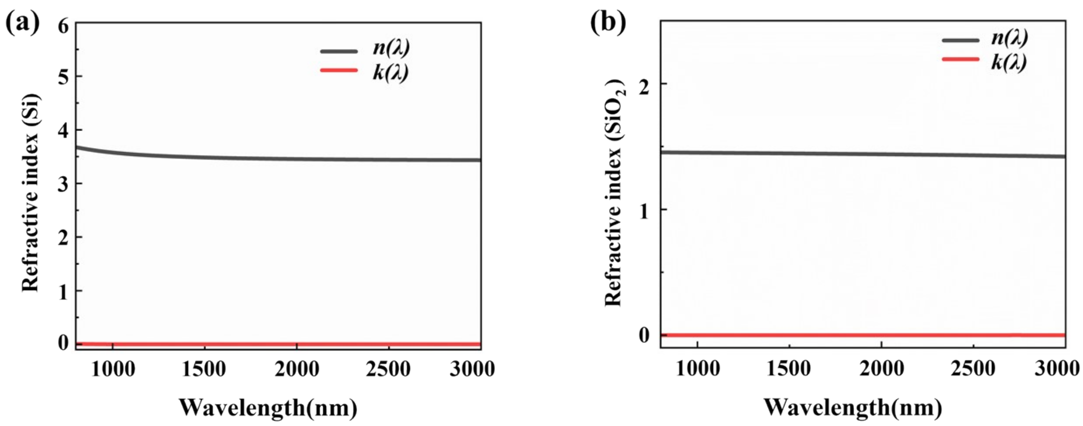

Fig. S1 (a) Complex refractive index parameter of Si; (b) Complex refractive index parameter of SiO_2. The black line represents the real part $n(\lambda)$, and the red line denotes the imaginary part $k(\lambda)$.

Section 2. Angular Robustness of Circular Dichroism (CD) Spectra at Small Off-Normal Incidence

Fig. S2 shows the circular dichroism (CD) spectrum of the proposed metasurface under oblique incidence, with incident angles θ ranging from –5° to +5° in 2° increments. All simulations used the same geometric parameters as in the text (Δd = – 5 nm). Under normal incidence (θ = 0°), the metasurface supports a strong intrinsic chirality quasi-BIC dominated by a toroidal dipole mode, producing a CD peak of approximately 0.7. When a smaller angular tilt is introduced ($|\theta| \leq 5°$), the CD amplitude decreases significantly, dropping to approximately 0.1 at θ = ±5°.

This performance degradation stems from the fact that intrinsic chirality quasi-BIC requires in-plane C_2 symmetry-breaking coupling under strictly normal incidence. Oblique incidence introduces extrinsic chirality and opens additional radiation channels, thus altering the interference conditions required for quasi-BIC. Consequently, the Q-factor decreases, and the CD response weakens.

These results demonstrate that the proposed quasi-BIC mode is highly sensitive to the incident angle, consistent with the expectation of symmetry-protected resonances, and exhibits the strongest CD response at perpendicular incidence.

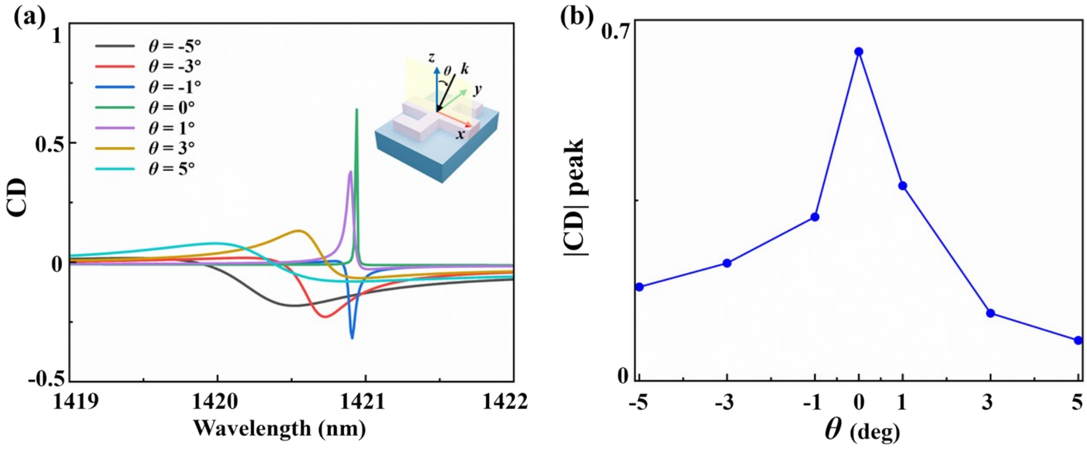

Fig. S2 (a) CD at Δd = – 5 nm with different incident angles; (b) |CD| peak under different incident angles.

References

[1] D. Franta, A. Dubroka, C. Wang, A. Giglia, J. Vohánka, P. Franta and I. Ohlídal, Applied Surface Science, 2017, 421, 405-419.