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Chiral acoustoplasmonics

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The possibility of creating and manipulating nanostructured materials encouraged the exploration of new strategies to control electromagnetic properties. Among the most intriguing nanostructures are those that respond differently to helical polarization, i.e., exhibit chirality [1,2]. Here, we present a simple structure based on crossed elongated nanobars with the long axis parallel to the polarization plane forming a given angle between them and vertically aligned, as shown in Fig. 1(a). We theoretically demonstrate that, in such structure, light-handedness defines the dominating cross-section absorption or scattering, with a 200% difference from its counterpart (scattering or absorption). The proposed chiral system opens the way to enhanced coherent phonon excitation and detection. In general, the generation of acoustic phonons is optimized by maximizing the absorption, while the detection is enhanced by engineering the scattering properties [3,4]. In chiral structures, this could be achieved by a simple pump-probe experiment using circularly polarized light at the same wavelength. The use of structures sustaining chiral optical modes appears as a natural, yet unexplored strategy to address these conditions. These results constitute one of the first steps towards harvesting chirality effects in the design and optimization of efficient and versatile acoustoplasmonic transducers.

References

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Figures

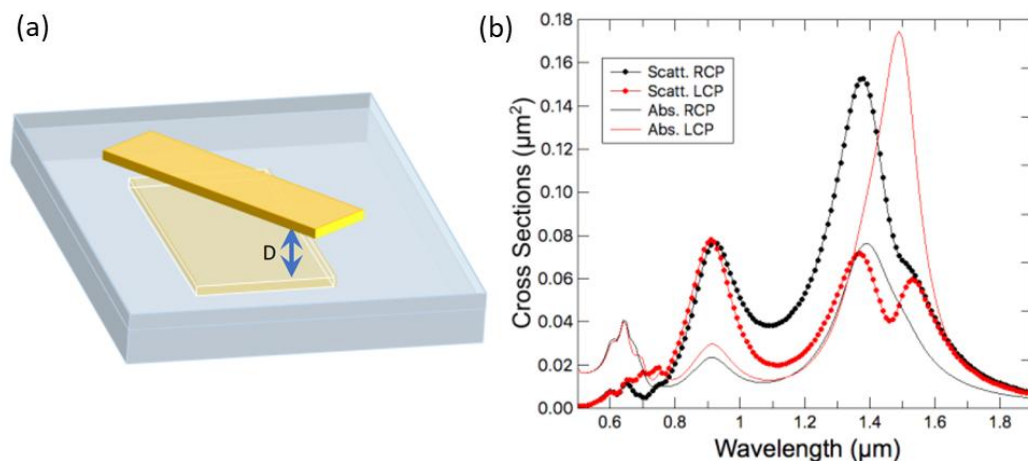


Figure 1: (a) Sketch of the geometrical layout of the chiral structure. Two gold nanobars separated by a distance $D = 80$ nm, with the long axis parallel to the polarization plane forming a given angle between them and vertically aligned. The bottom bar is embedded in SiO₂ while the top bar sits on the surface of SiO₂. (b) Absorption and scattering cross-sections for right (RCP) and left (LCP) circularly polarized incident beam.