Harnessing all-dielectric metamaterials to manipulate the polarization state of light

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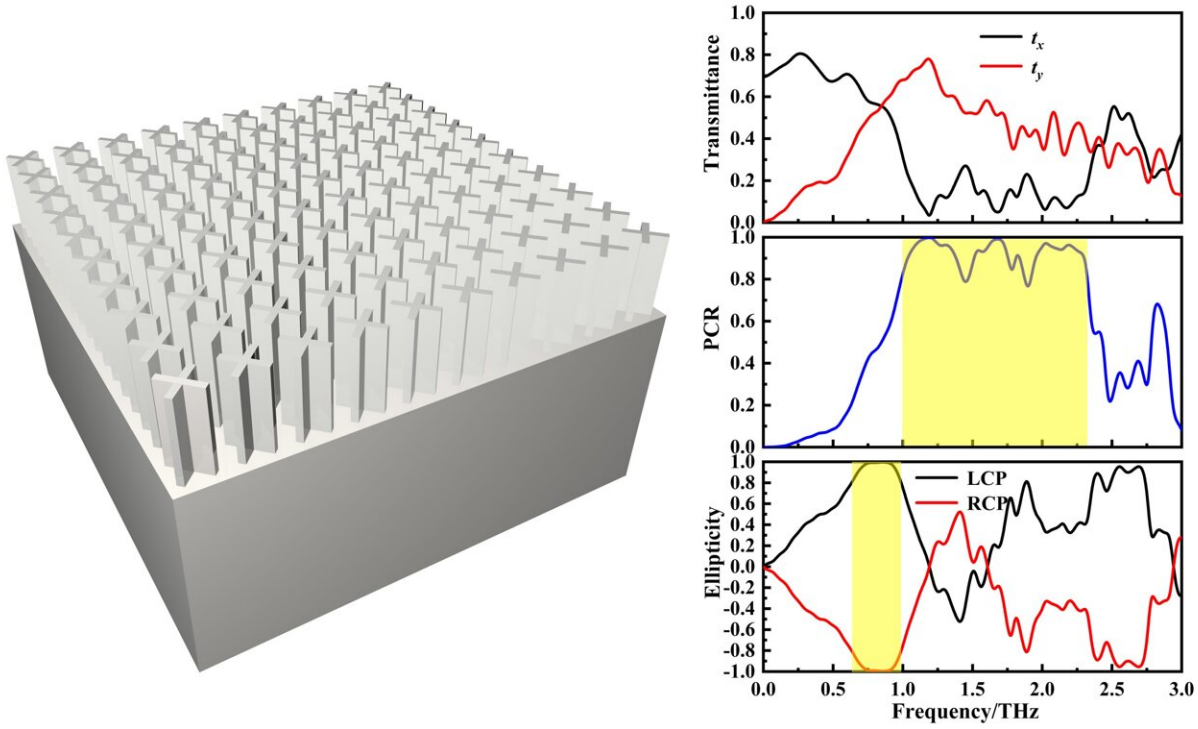

Schematic diagram of the structure and polarization conversion effects. Credit: *Frontiers of Optoelectronics* (2023). DOI: 10.1007/s12200-023-00098-9

Polarization is one of the fundamental characteristics of electromagnetic waves. It can convey valuable vector information in sensitive measurements and signal transmission, which is a promising technology for various fields such as environmental monitoring, biomedical

sciences, and marine exploration. Particularly in the terahertz frequency range, traditional device design methods and structures can only achieve limited performance. Designing efficient modulator devices for high-bandwidth terahertz waves presents a significant challenge.

Researchers led by Prof. Liang Wu at Tianjin University (TJU), China, have been conducting experiments in the field of all-dielectric metamaterials, specifically focusing on utilizing these materials and their structural design to achieve effective broadband polarization conversion in the terahertz frequency range.

They propose a cross-shaped microstructure metamaterial for achieving cross-polarization conversion and linear-to-circular polarization conversion in the terahertz frequency range. The study, titled "An all-silicon design of a high-efficiency broadband transmissive terahertz polarization convertor," was published in *Frontiers of Optoelectronics*.

Within a wide frequency range of 1.00 to 2.32 THz, the average conversion efficiency of cross-linear waves exceeds 80%, with the highest conversion efficiency peak reaching an impressive 99.97%. Additionally, the employed structure facilitates the conversion from linear to circular polarization, with an ellipticity of 1 at 0.85 THz.

This work by the researchers also provides valuable insights for the design of other metamaterials capable of broadband, high-efficiency, and multi-polarization mode manipulation.

More information: Xiaohua Xing et al, An all-silicon design of a high-efficiency broadband transmissive terahertz polarization convertor, *Frontiers of Optoelectronics* (2023). DOI: 10.1007/s12200-023-00098-9

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