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Highly Efficient Chiral Plasmonic Metasurfaces for Mid-Infrared Polarization Filtering and Detection

Background

Polarization detection and manipulation techniques have wide-ranging applications, from glare-reducing glasses, liquid-crystal displays and 3D movies to optical communication, spectrometry, hologram generation, biomedical diagnosis, chemical analysis, and target detection. Conventional methods for polarization detection and manipulation require bulky optical systems with rotating polarizers and quarter-waveplates, which hinder cohesive integration. Moreover, mid-infrared (mid-IR) optics often require special materials such as chalcogenides or halides as well as complex fabrication methods, which lead to higher costs and inferior performance compared to optics in the visible or near-infrared range.

Invention Description

Researchers at Arizona State University have developed highly efficient circular polarization (CP) filters based on stacked plasmonic metasurfaces with high efficiency (93%), high extinction ratio (93), and subwavelength thickness (~500nm) in mid-IR. These filters can generate CP with input light of arbitrary polarization states. By integrating the CP filters with LP filters on the same chip, Stokes parameter detection is able to be performed with high accuracy. Such a design can be tailored to operate over a broad wavelength range from 1.8 to 5μm and is ready to be integrated onto photodetector arrays for direct polarization imaging in mid-IR.

Potential Applications

- Semiconductor-based photodetectors
- On-chip polarization detectors
- Circular dichroism (CD) spectroscopy
- Biomedical imaging
- Optical communication
- Target detection

Benefits and Advantages

- High-efficiency polarization filter (93%)
- High extinction ratio of 93
- Subwavelength thickness (~500nm) in mid-infrared
- Compact form allows integration directly onto various image sensors or focal plane arrays

Laboratory Homepage of Professor Yu Yao