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Compact, High-Speed Metasurface Mueller Matrix Microscope

Background

Polarization techniques are widely used to inspect sample material scattering, optical birefringence, and other material properties. One of polarization microscopy's major limitations is that it evaluates sample polarization properties qualitatively due to the lack of complete polarization information.

Mueller matrix microscopy (MM) is a polarization microscopy technique that provides complete polarization information including linear retardance and depolarization. MM is widely used in biomedical and clinical research, chemical analysis, and industry imaging due to its ability for simultaneous determination of many material properties. However, most existing Mueller matrix microscopes (MMMs) operate in a single mode and have bulky optical components with limited measurement speed.

Invention Description

Researchers at Arizona State University have developed Meta-MMM, a novel Mueller matrix microscope (MMM) based on a dual-wavelength metasurface polarization state generator (PSG) and chip-integrated metasurface full Stokes polarimetric imaging sensor. Meta-MMM is compact and versatile, providing higher speed and dual-mode capabilities. The PSG that Meta-MMM utilizes is compact in size, and requires four times less measurement numbers, contributing to faster measurement speed. Meta-MMM can be operated at both reflection and transmission modes, allowing for a much broader range of applications at high speed.

Potential Applications

- Biomedical imaging
- Material analysis
- Industry inspection
- Biological and clinical research
- Optical characterizations of photonic devices

Benefits & Advantages

- Compact (based on chip-integrated polarization analyzers and generators)
- Broader range of applications at high speed (operates in reflection and transmission modes)
- High measurement accuracy
- High full Stokes polarization detection
- Faster measurement speed (requires less measurement numbers to operate)