Docket #: S21-110

Tunable and achromatic waveplates with arbitrary polarization axis

Researchers at Stanford have developed a method for tuning the polarization state of light achromatically and along arbitrary polarization axes. This technology may be extremely useful in experimental research, commercial polarization instrumentation, and industrial machinery. Today, polarization manipulation across multiple wavelengths is a critical task for many applications such as ellipsometry or pulsed laser systems. However, there is no method for dynamically tuning the polarization state of light across a large bandwidth. Current solutions experience various dispersion effects and largely operate in the linear polarization basis, limiting the operations that can be performed. **In contrast, the Stanford technology provides arbitrary polarization axes, enabling full manipulation of the polarization space**. The device features two identical polarizing beamsplitter elements configured such that as they move relative to each other, two split beams will experience a displacement phase shift. The displacement of the waveplate can be easily adjusted to provide dynamic polarization tuning of the incident light.

Stage of Development
Prototype

Applications

- Ellipsometry, spectro-polarimetric imaging, and ultra-fast laser polarization optics (e.g., high performance infrared sensors)

Advantages

- Compared to ellipsometry:

- **Broadband** - there are other ways to convert polarization but they are narrow band
- **Speed** - orders of magnitude faster than the current state of the art
- **Cost** – significantly less expensive than current techniques
- **Simple mechanical design** made from low cost parts (totaling about $300 off the shelf)

Publications

- Wang, E. W., Phan, T., Yu, S. J., Dhuey, S., & Fan, J. A. (2022). Dynamic circular birefringence response with fractured geometric phase metasurface systems. *Proceedings of the National Academy of Sciences, 119(12),* e2122085119.

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