Advance in light filtering technology has implications for LCD screens, lasers and beyond

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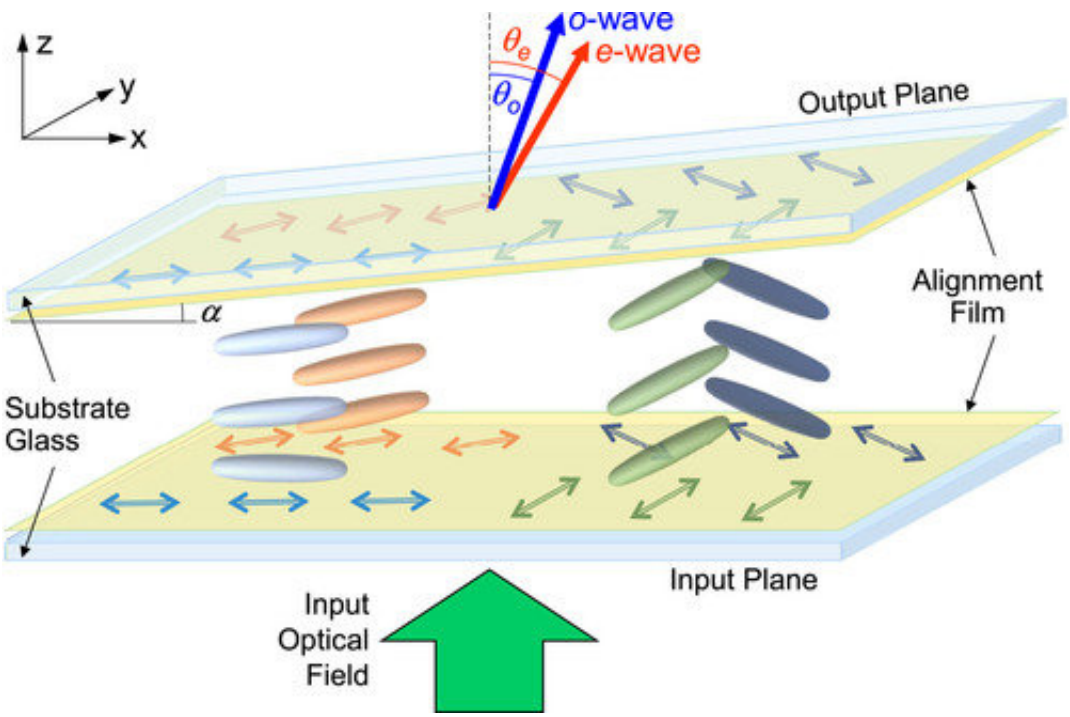

Credit: American Institute of Physics

Vector polarizers are a light filtering technology hidden behind the operation of many optical systems. They can be found, for instance, in sunglasses, LCD screens, microscopes, microprocessors, laser machining and more. Optical physicists from Nanjing and Nankai University, China, and the University of Central Florida, U.S., published details of

their new vector polarizer design this week in *APL Photonics*. The newly proposed design is a major advance in polarization technology because it enables flexible filtering of a wide range of light sources and generation of new light states.

Light waves can oscillate with their back-and-forth motion oriented along different directions, where its polarization describes the nature of this orientation. A traditional polarizer, like a lens from polarized sunglasses, filters out light oscillating along all but one direction. The filtered light is referred to as polarized light.

"An enormous challenge was how to solve the design and fabrication of vector polarizers to tailor the light beams and satisfy the requirements of various applications," said Hui-Tian Wang, an author of the study. Wang's group achieved a design that can tailor light intensity, phase and polarization. "The vector polarizer can significantly improve the generation efficiency of vector light beam and may be conducive to achieving a high-performance vector laser."

These advancements can be used to improve a variety of optical systems. In super-resolution microscopy, for instance, manipulating polarization can be used to achieve far-field focusing beyond normal diffraction limitations.

The physicists increased polarizer efficiency and flexibility by using a new liquid-crystal-based design that relies on birefringence, where specific polarizations are filtered based on their refractive indexes. Wang explained that they customized the orientation of liquid crystal molecules by using stringent photo-alignment techniques. They determined the dichroic dye film structure within the thin glass compartment before adding the liquid crystal.

The new vector polarizers also feature manufacturing advantages. "They

are flexibly designed and easily fabricated, and have the advantages of the large-size complex structures and the broadband [light waves] operation," Wang said. "However, the vector polarizer we proposed still needs some improvements. For example, we need to improve its alignment quality, i.e., the quality of generated light beams. We also need to improve the spatial resolution for controlling the orientation of liquid crystal molecules."

Wang is particularly excited about this vector polarizer's ability to generate new polarized light states, which he hopes to use in developing novel applications. As an example, entangled vector photon states could be used in developing technology for quantum communications.

More information: Gui-Geng Liu et al, Dielectric broadband meta-vector-polarizers based on nematic liquid crystal, *APL Photonics* (2017). DOI: 10.1063/1.5006016

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