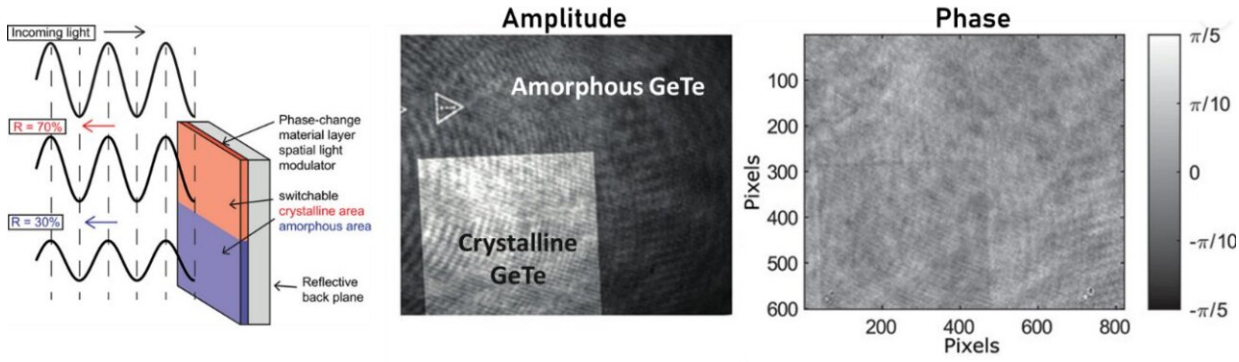
A route to ultra-fast amplitude-only spatial light modulation using phase-change materials

August 9 2023



Why is it important not to affect the optical phase? Credit: IO-CSIC

A team of researchers from the Center for Research and Innovation in Metamaterials at the University of Exeter and the Laser Processing Group at the Institute of Optics have presented in the journal *Advanced Optical Materials* a one-of-a-kind spatial light modulator capable of of performing a potentially ultra-fast, amplitude-only modulation without modifying the optical phase.

This innovative technology is based on the use of chalcogenide phase change materials, and achieves improvements that could be exploited in fields such as wave front shaping experiments, communications,

detection and grayscale imaging.

The device consists of a thin GeTe layer, and operates like a reconfigurable mirror where by changing the material between its amorphous and crystalline states, a gradual change of the amplitude of the reflected light becomes accessible without modifying the optical phase.

Discrete, amplitude-only modulation of light can increase the degrees of freedom of wave front shaping experiments, by combining such devices with their phase-only counter-parts based on liquid crystals.

The experimental results show an absolute intensity modulation of 38% (relative modulation of 233%), with a minimal shift in the optical phase of less than $\approx\pi/50$ along the measured areas. Moreover, the cycling of GeTe and other chalcogenides of its family is inherently fast, offering rapid transition rates of the order of nanoseconds or less (i.e. faster than current liquid crystal technologies).

The research team stresses that this work paves the way for the development of a new class of ultrafast, non-volatile, and energy-efficient spatial amplitude modulators. In addition, the device ease of fabrication combined with its inherently rapid switching speeds would allow its integration in electrically controlled pixelated devices.

More information: Joe Shields et al, A Route to Ultra-Fast Amplitude-Only Spatial Light Modulation using Phase-Change Materials, *Advanced Optical Materials* (2023). DOI: 10.1002/adom.202300765

Provided by Spanish National Research Council