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Optical metasurfaces created by ion irradiation of phase transition materials

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Active, widely tunable optical materials have enabled rapid advances in photonics and optoelectronics, especially in the emerging field of meta-devices. Of the tunable optical materials, one of the most prolifically studied is the VO2, which undergoes a reversible IMT as the temperature reaches a critical temperature of approximately 67℃ due to strong electron correlations.
Energetic ion beams are widely used to modify the electronic and structural properties of solids by introducing impurity atoms into the crystal lattice. Commonly, the inevitable formation of irradiation damage during ion bombardment is described as disadvantageously for ion beam doping and subsequent post-implantation annealing procedures are required. Since the electronic structure of strongly electron correlated materials is very sensitive to small amounts of lattice defects, ion beam induced damage formation combined with lithographic patterning can be used to locally adjust the phase transitions of these materials. Using this robust technique, optical metasurfaces, including tunable absorbers with artificially induced phase coexistence and tunable polarizers based on thermally triggered dichroism are demonstrated.

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