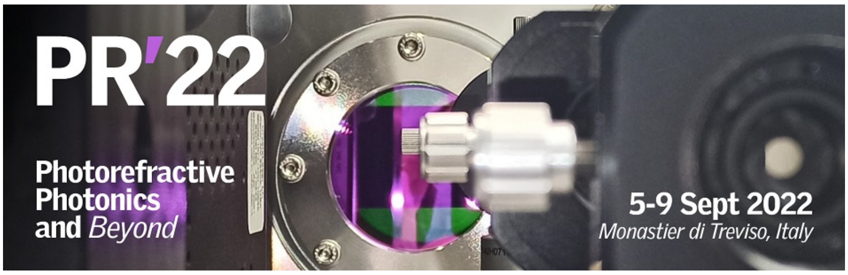

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All-optical switching on plasmonic-lithium niobate metasurfaces

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Ferroelectric crystals can modify their optical properties by producing photo-excited carriers when exposed to moderate laser power. This change stems from the direction-dependent photovoltages developed along the c-axis of the ferroelectric crystal. Here, we harness the pyroelectric, photorefractive and photoelastic effects to induce reversible (pyroelectric and photoelastic) and irreversible (photorefractive) transmittance changes on plasmonic-lithium niobate metasurfaces.
We prepare two types of plasmonic-LiNbO_{3} metasurfaces by depositing either ~30 nm of copper (Cu) or Indium Tin Oxide (ITO) on commercially available x-cut congruent films of LiNbO_{3} (thickness ~100 µm). Next, we anneal the samples (from 400 oC up to 800 oC), thereby transforming Cu into CuO and increasing the transparency of ITO. At the same time, ions diffuse into the LiNbO_{3} crystals, creating deep and shallow traps. We subsequently deposit 50 nm gold films and fabricate photonic metasurfaces of subwavelength, periodic nanohole arrays.
We set-up a pump-probe experiment on a home-built microscope based on lock-in detection technique, thereby record transmittance changes induced on the plasmonic-lithium niobate metasurfaces at the probe laser beam (1064 nm), from the pump laser beam (532 nm).We present various configurations where the pyroelectric, photorefractive and photoelastic effects induce volatile and non-volatile transmission changes. The relative modulation depth of the probe beam exceeds 150% with up to 2 ms response time, induced by a few mW (<5mW) of the pump power.
Our results pave the way for a new type of compact, all-optical switching scheme for flat optics.

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