Zero-to-full transmission switch with GST225-loaded all-dielectric metasurface

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Nonlinear and tunable nanostructures provide extraordinary abilities to control the optical response of modern functional photonic devices at the nanoscale. Recently emerged phase change materials demonstrate a dramatic and reversible change in dielectric properties under the influence of laser pulses or electric current and hence provide an enormous potential for integrated tunable nanophotonic devices [1,2].
In this work, we show that the use of phase-change material (GST225) allows us to design an all-dielectric metasurface with zero-to-full transmission switch occurring at the phase transition. The structure is designed to operate at the telecom wavelength (1.5 um) vital for all-optical communications and data processing. Metasurface geometry is represented in fig. 1. It consists of silicon nanodiscs placed atop GST nanodiscs with the same diameter. Light transmission/reflection under normal incidence in the NIR range demonstrates a dramatic change in transmission (fig. 1). Figure 2 shows the effect of zero-to-full transmission switch in this structure occurring in the case marked with a cross in fig. 1. We believe that this metasurface can be used as a power limiter in nanophotonic devices.

References

[1] S. Abdollahramezani et al., arXiv:2001.06335 (2020).
[2] M. Wuttig et al., Nat. Photon., 11 (2017) 465

Figures

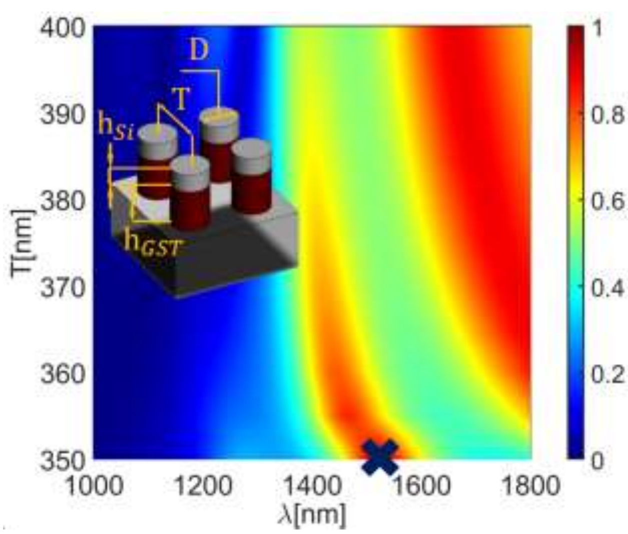

Figure 1: Absolute value of transmission difference between amorphous and crystalline states of GST nanocylinders vs period T and wavelength λ. Inset: schematic geometry of the metasurface. The regime of interest is marked with the cross.

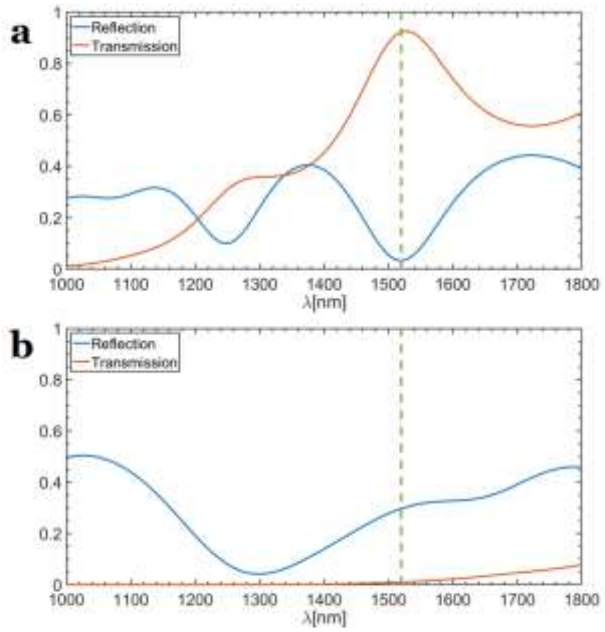

Figure 2: Reflection (red) and transmission (blue) for (a) amorphous and (b) crystalline states. The peak in transmission at 1520 nm in the amorphous state corresponds to the mark in fig. 1.