Performance optimization of a metasurface incorporating non-volatile phase change material

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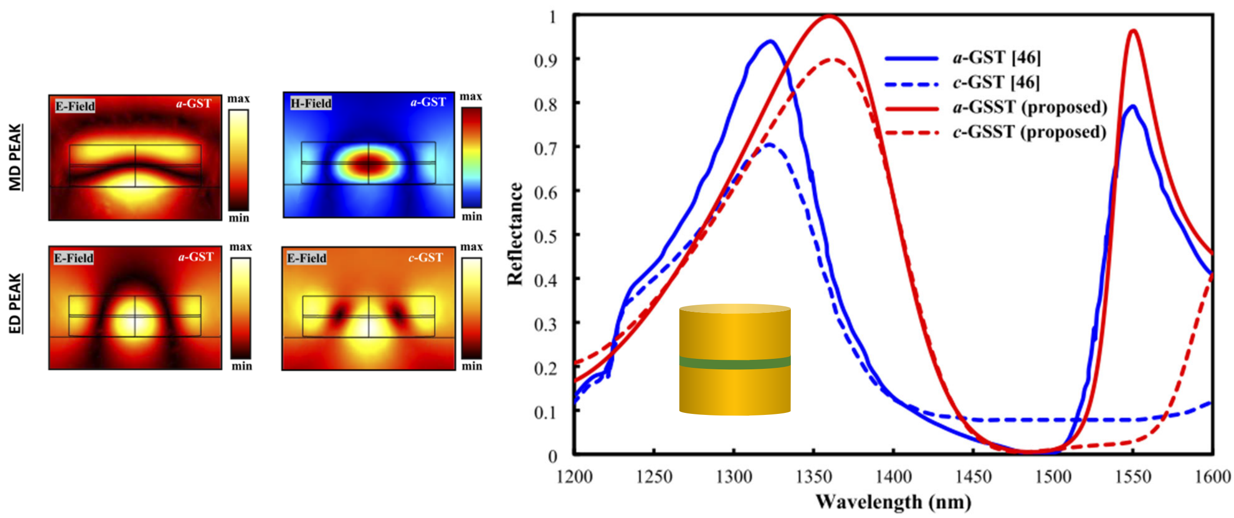
Rationale and objective: Phase change materials (PCMs) is a well-known material for two decades, however, by integrated the phase change material into the metamaterial is still opened to study. This research work is applied PCM into metamaterial and focused on the 1550 nm which is the range for telecommunication. Hence, the proposed structure shows the switchable property in 1550 nm for further applications.

Summary: In this work, we numerically investigate an array of silicon cylinders with a thin PCM layer at their centers. The GST and GSST are the most well-known PCMs and were chosen for this study due to their non-volatile properties. This structure produces two resonant modes, magnetic dipole and electric dipole, at two different resonating wavelengths. We have numerically simulated the effect of cylinder's height and diameter on the reflecting profile, including the effect of thickness of the phase change material. Additionally, it is shown here that a superior performance can be achieved towards reduced insertion loss, enhanced extincti on ratio, and increased figure of merit when a GST layer is replaced by a GSST layer.



Graphical summary: (Left) The field distributions for both resonant frequencies in amorphous and crystalline state of GSST. (Right) The reflectance spectrum of the proposed structure (shows in cylindrical unit cell) represents two resonant modes.

Outcome: The proposed structure provided 2 resonant frequencies located at 1360 nm and 1550 nm with the high reflectivity (higher than 0.9) for the amorphous state of phase change material. After the transition (amorphous to crystalline) one resonance at 1550 nm shows the switchable property by dramatically decrease the reflectivity to 0.02. Which could leads to the applications in telecommunication.

Related publications:

1. Natsima Sakda, Souvik Ghosh, Ratchapak Chitaree, and B. M. Azizur Rahman, "Performance optimization of a metasurface incorporating non-volatile phase change material," Opt. Express 30, 12982-12994 (2022)