Supplementary information for the article

Switchable wire-grid polarizer based on phase-change material GST

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An important property of the designed metasurface is that it retains its filtering characteristics over a wide range of incident angles away from normal to the sample surface. This suggests that the developed wire-grid polarizer can operate not only for a normally incident plane wave but also for a Gaussian beam focused on the metasurface region. In Fig. S1 we provide distribution of the field of a Gaussian beam. One can see that indeed, the designed GST grating transmits the s- (p-) polarized Gaussian beam in the amorphous (crystalline) state while blocking the p- (s-) polarized Gaussian in the amorphous (crystalline) state.

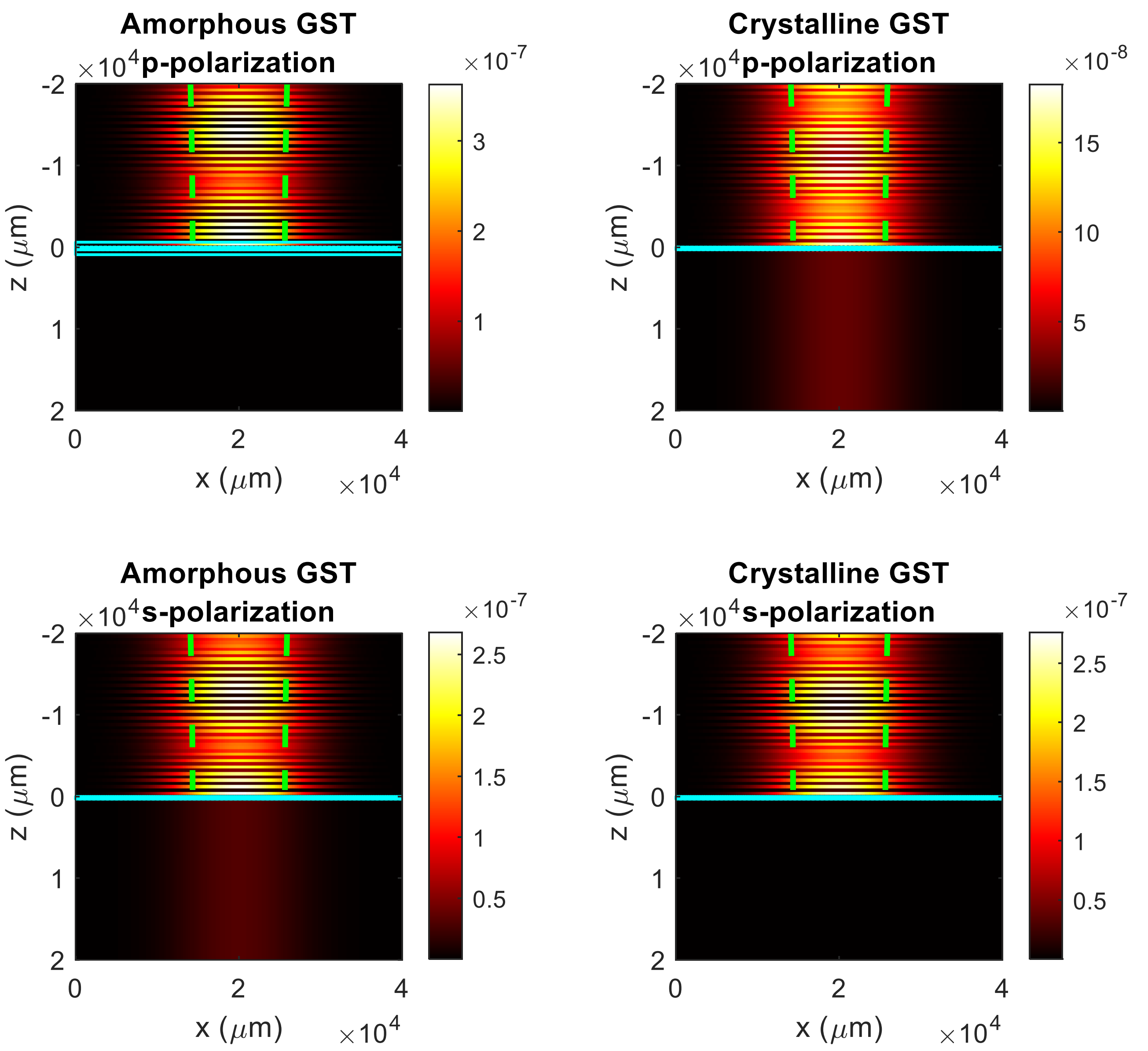

Fig. S1 The field profiles of a Gaussian beam incident on the GST metasurface in amorphous and crystalline phases calculated in x- and y-polarizations. Parameters of the Gaussian beam: angular divergence – 10°, wavelength – 1550 nm, angle of incidence – 0°, beam waist is located at the upper surface of the grating.

Despite being sensitive to variations of geometric parameters at a single wavelength, the designed structure appears to be quite stable when considering any wavelength in the range 1500-1600 nm as a target wavelength. Fig. S2 demonstrates that under this generalization, the structure works as a switchable polarizer across a wide range of geometric parameters.

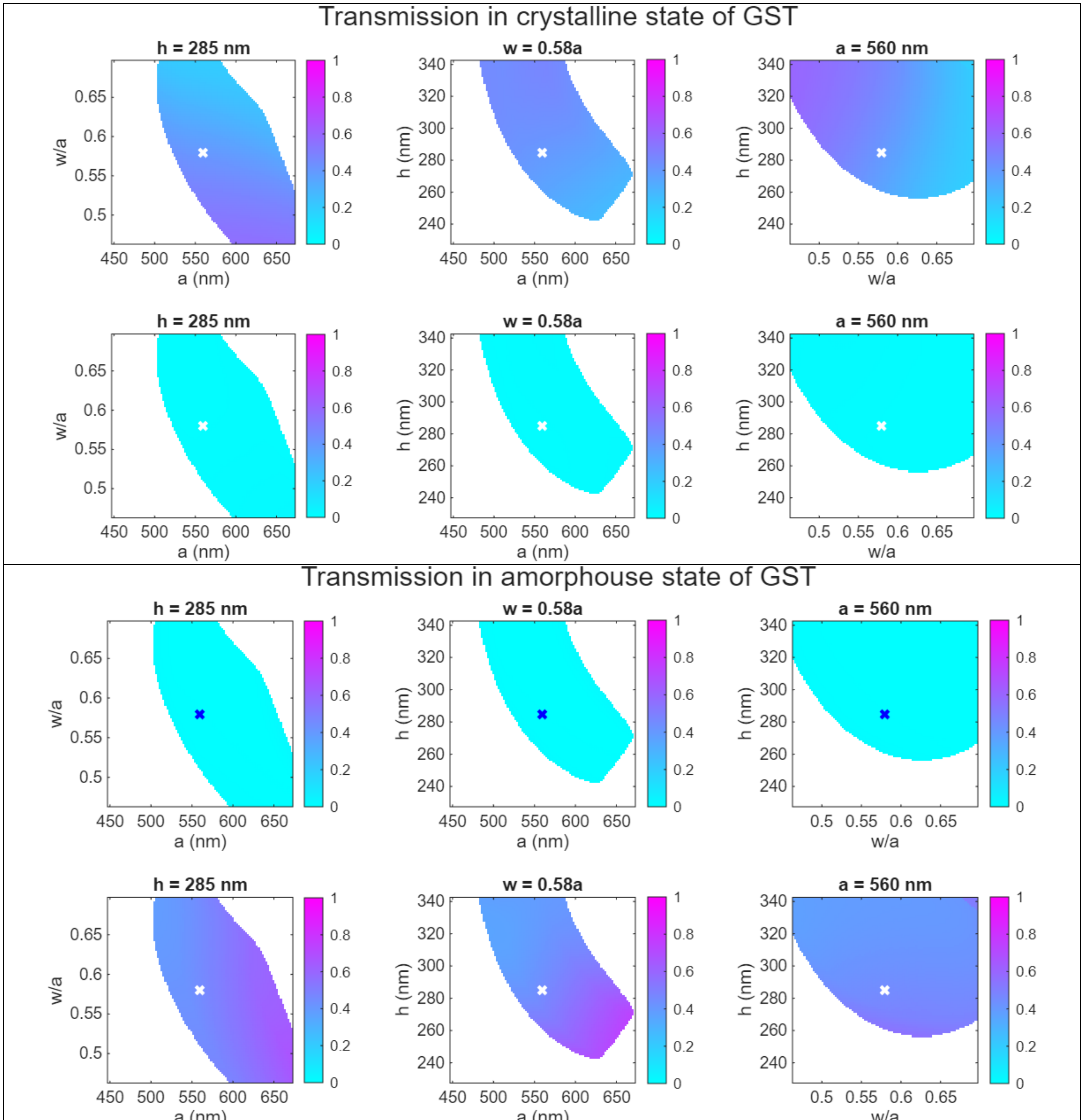

Fig. S2 The colormaps of the transmission coefficient taken at a wavelength where the overall polarization efficiency reaches its spectral maximal value f_{max} falling within the wavelength range 1500–1600 nm. The colormaps are shown as functions of the parameters a, h and w for the crystalline and amorphous GST phase in x- and y-polarizations.

We have performed an experiment to demonstrate the reversibility of the GST phase state. We carried out thermal crystallization of as-deposited films using a furnace. After that amorphization of samples was performed by laser scanning. Subsequently, we demonstrated the ability to transform the formed amorphized regions back into their crystalline state through further application of heat treatment [Fig. S3(b)]. Also, we performed a series of sequential crystallization/amorphization of sample using the laser without any involvement of the furnace. The results of cyclic switching are illustrated with rectangular markers in Fig. S3(c): thermal crystallization of the initial amorphous sample (1st), laser-induced amorphization (2nd and 4th), and laser-induced crystallization (3rd). These results indicate that the optical switching is reversible, even if not yet integrated into an electrically driven device format.

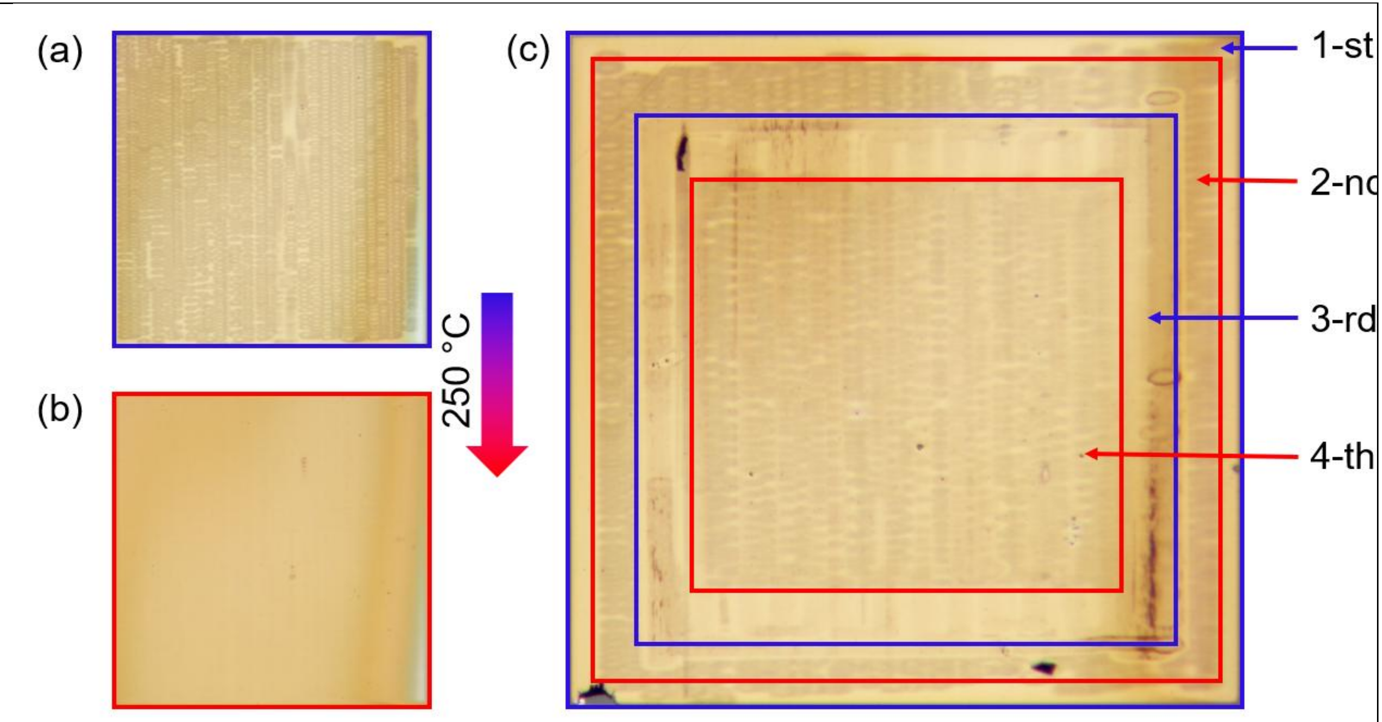

Fig. S3. Top view of the crystallized GST sample after laser amorphization (a) and subsequent crystallization by heating to 250 °C (b). The results of cyclic switching are shown with rectangles (c): thermal crystallization of the as-deposited sample (1st), laser amorphization (2nd and 4th), laser crystallization (3rd).