High-performance optical switches based on GST/Si waveguides

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Phase change materials (PCMs), such as germanium-antimony-tellurides [1] or vanadium dioxide [2], are promising materials to combine with silicon (Si) photonics devices. In this field, $Ge_2Sb_2Te_5$ or GST stands out due to the large and non-volatile variation of its refractive index when switching between an amorphous and crystalline state [3]. This singular attribute permits the development of ultra-compact and high-performance optical switches based on hybrid GST/Si waveguides. In this work, an optical switch based on a ring resonator structure has been designed and optimized to achieve a high extinction ratio and low insertion losses. The device has also been fabricated and experimentally demonstrated. Figure 1(a) shows an optical microscope image of the fabricated optical switch based on a silicon ring resonator structure with an ultra-short GST/Si waveguide as the active element. The GST/Si waveguide has a length of only 500 nm. The optimal GST thickness has been analyzed and experimentally tested to avoid coupling of undesired higher-order modes. The experimental transmission response of the switch is shown in Fig. 1(b). An extinction ratio above 24 dB and almost negligible insertion losses are achieved at the resonance wavelength when the GST is switched between the amorphous and crystalline states.

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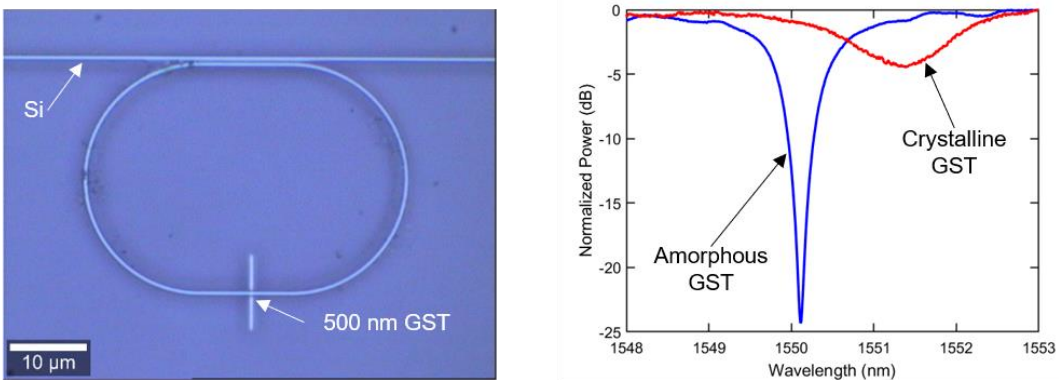
FIGURES



(a) (b)

Figure 1: (a) Optical microscope image of a fabricated silicon ring resonator with a 500-nm-long GST/Si waveguide. (b) Experimental transmission response when switching between the amorphous and crystalline states of the GST.

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