Wide beam steering by slow-light waveguide gratings and a prism lens

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A lattice-shifted photonic crystal waveguide (LSPCW) maintains slow light as a guided mode and works as an optical antenna when a kind of double periodicity is introduced. Selecting one LSPCW from its array and converting the fan beam to a spot beam using a collimator lens allows non-mechanical, two-dimensional beam steering. We employed a shallow-etched grating into the LSPCW as the double periodicity to increase the upward emission efficiency and designed a bespoke prism lens to convert the steering angle in a desired direction while maintaining the collimation condition for the steered beam. As a result, a sharp spot beam with an average beam divergence of 0.15° was steered in the range of ${40}^\circ \; \times \;{4.4}^\circ $ without precise adjustment of the lens position. The number of resolution points obtained was 4256. This method did not require complicated and power-consuming optical phase control like that in optical phased arrays, so it is expected to be applied in complete solid-state light detection and ranging.

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