Topology optimization of asymmetric Y-junction for air-bride type photonic crystal slab waveguides

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A Y-junction in a two-dimensional (2D) photonic crystal (PC) slab waveguides (WGs) serves as an important component for integrating dense and compact all-optical devices such as a PC-based symmetrical-Mach-Zehnder type switch (PC-SMZ) [1]. In this work, topology optimization (TO) method [2] has been applied to design an asymmetric Y-junction in an air-bridge type 2DPC slab WGs. The optimized junction exhibits quite a good performance with low-loss, wide/flat bandwidth and excellent wavelength selectivity between signal and control pulses, as shown in Fig. 1. Further, the size of the component is drastically reduced compared to the conventional directional coupler with coupling length ~240*a* [3], where *a* is a lattice constant of the PC.

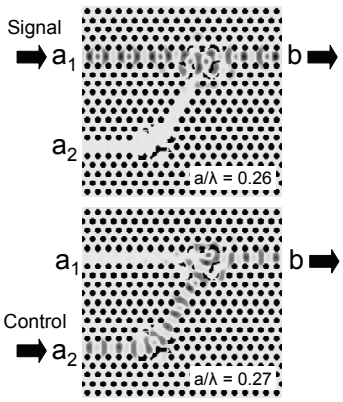

Fig. 1. Snapshots of the guided lightwave (at the normalized frequencies *a*/λ of 0.26 and 0.27) through the TO junction.

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[3] Y. Tanaka et al., *Appl. Phys. Lett.* **86**, 141104 (2005).