Reconfigurable photonics on a glass chip

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We present experimental results on evaluation of the fully reconfigurable universal multiport architecture on the femtosecond laser-written platform. Furthermore, we propose new class of integrated reconfigurable devices comprised of multiple waveguide lattices and a pattern of the thermooptical phaseshifters and investigate the reconfigurability features of such devices.

We demonstrate a 4-by-4 multiport thermooptically tunable interferometer fully fabricated using the femtosecond laser writing technology. Currently lithography is the technological standard for fabricating reconfigurable photonic circuits. However, femtosecond laser writing provides the capability of very fast and cheap prototyping of both passive and active integrated photonic chips directly in the optical lab. We use the universal multiport interferometer design to achieve full reconfigurability of the device. The fabricated device performs at a switching time of 10 ms setting a record for tunable femtosecond laser written devices. We present a thorough analysis of reconfigurability using an adaptive tuning strategy and provide an accurate account of the imperfections of reconfigurable devices fabricated with the femtosecond laser writing technology and possible approaches to overcome the reported issues.

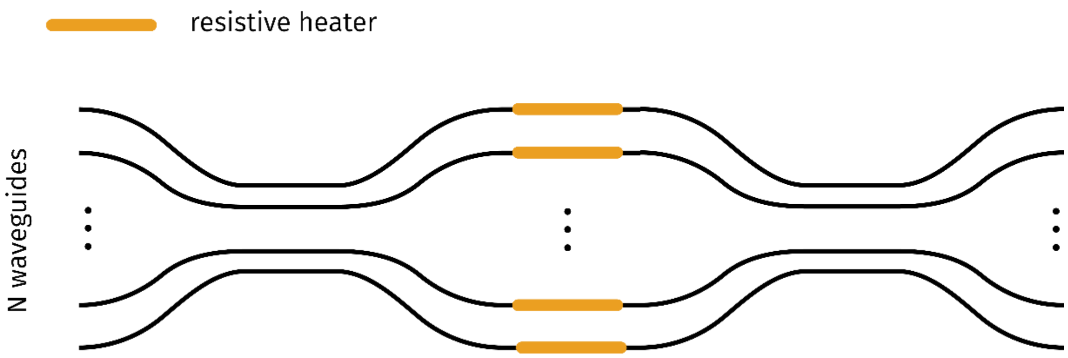

Figure 1. The schematic of the tunable waveguide lattice. The elementary device consists of a pair of waveguide lattices with predefined geometry. The relative phases between different arms of the interferometer are tuned by thermooptical phaseshifters.

The tunable waveguide lattices (see Fig.1) may serve as a special tool for experiments which don't require full reconfigurability. We provide numerical results on the capabilities of such architecture and define classes of transformations which can be realized with high fidelity. The interest to such type of devices is dictated by novel multiphoton effects recently discovered in [1-2].

References:

1. A.J. Mensen, et al. Phys. Rev. Lett. 118, 153603 (2017)
2. V.S. Shchesnovich and M.E.O. Bezerra, arXiv:1707.03893v2 (2018).