























to shift the whole channel to a higher center wavelength is now reduced, since the crosstalk reuses the power sent to one ring in the other ring. The latter translates into an increase of the effective tuning efficiency of the channel. This effective tuning efficiency is calculated by computing the average frequency shift per unit of delivered power, taking into account the measured crosstalk: microheater A shifts a total of 53 GHz (45 GHz for ring A and 8 GHz for ring B) with 1.5 mW, and microheater B shifts 83 GHz (25 GHz for ring A and 58 GHz for ring B) with 2.1 mW. This results in 35.3 GHz/mW for microheater A and 39.5 GHz/mW for microheater B, which gives an average frequency shift of 37.4 GHz per mW for the whole channel. This corresponds to a thermo-optic efficiency of 27  $\mu\text{W}/\text{GHz}$ , which is the value used in Subsections 3.1 and 3.2. This value is in good agreement with the value of 28  $\mu\text{W}/\text{GHz}$  from Ref. 4. This similarity is expected, since the waveguide and ring dimensions are similar in both works, as well as the HSQ overcladding and the vertical separation between the waveguides and the heaters.

To reduce thermal crosstalk, additional thermal isolation techniques can be constructed, such as etched air trenches close to and under the microring waveguides [22,23]. This technique would permit a reduction in the spacing between channels while maintaining negligible channel crosstalk, and would increase the direct thermo-optic efficiency. Further enhancement in the tuning efficiency can be achieved by directly integrating the microheaters with the resonator, using adiabatic resonant microrings [24].

#### 4. Conclusion

We fabricated a twenty-channel second-order dual filterbank in a silicon-on-insulator platform, and demonstrated the precise tuning and reconfigurability of eleven channels. The filterbank has a tunable channel spacing which was set to 124 GHz, single-channel bandwidths of about 20 GHz, and  $-45$  dB crosstalk between channels. A counter-propagating filterbank was also studied, and the two drop-port responses of one of the channels were shown to have identical filter responses. The effective (average) tuning efficiency was calculated to be  $\sim 27$   $\mu\text{W}/\text{GHz}/\text{ring}$ , obtained through measurement of crosstalk between the two rings of a channel. The average power dissipated on the dual filterbank chip set to the channel spacing of 124 GHz is estimated to be around 16 mW per channel. This device has potential applications in on-chip WDM applications, or as a multiplexer in optically sampled analog-to-digital converters.

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