Fundamentally Cancel Backscattering in Silicon Microrings

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Silicon microrings have proven their value in numerous optical applications. Usually it's desirable for them to have a high Q factor, thus a very narrow linewidth. But this will frequently facilitate resonance splitting because sidewall roughness induces backscattering and this couples the clockwise (CW) and counter-clockwise (CCW) propagating modes in the ring waveguide [1]. As a consequence their degeneracy will be broken. Resonance splitting is problematic in almost all of the microring based applications. Even if the splitting can be avoided by broadening the resonance linewidth, the backreflection to the *in* port and unwanted transmission to the *add* port are still inevitable. These two effects can cause unwanted interferences in larger circuits or cause laser instabilities.

So far no satisfactory solution has been proposed to deal with backscattering [2]. Here we show that by putting an intentional tunable reflector inside the ring to compete with the stochastic backscattering, we are able to effectively avoid resonance splitting and supress the reflection to the *in* port and leakage to the *add* port, as evident in Fig. 1. The schematic is shown in Fig. 2. The microring now contains a tunable reflector, which is a loop-end Mach-Zehnder-Interferometer that can provide a reflectivity from 0 to almost 100% by a pi phase shift.

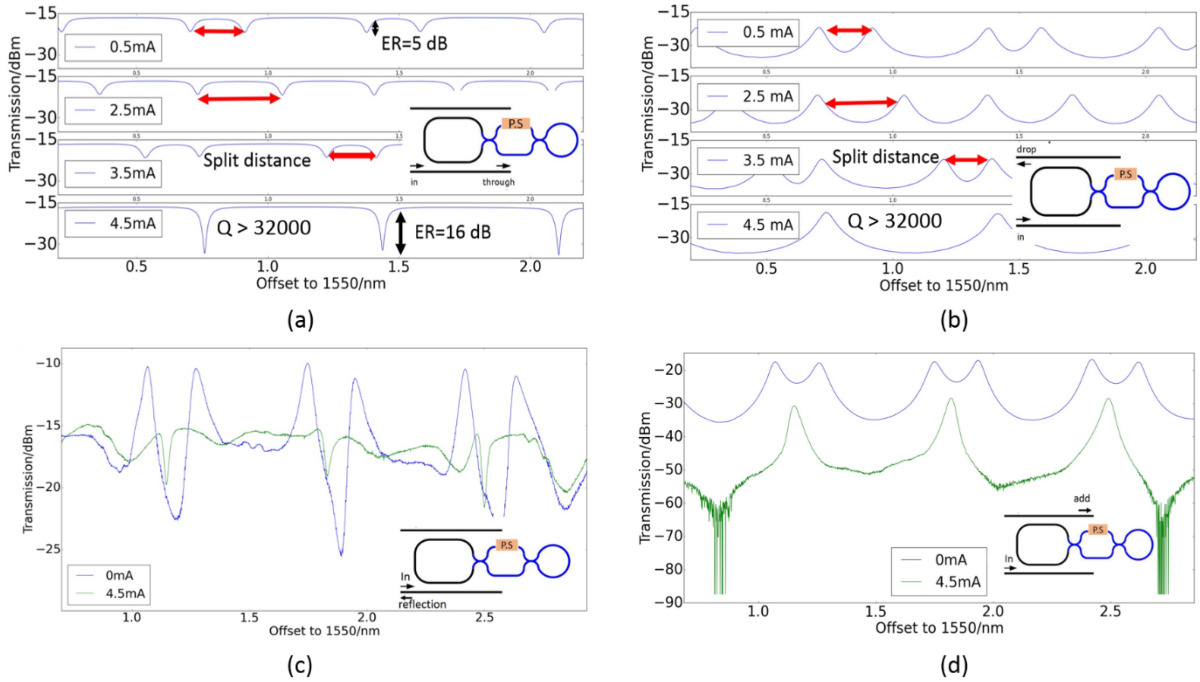

Fig. 1. Measured spectra of (a) through port, (b) drop port, (c) reflection and (d) add port under different tuning current. With the proper phase change, resonance splitting at through and drop port is eliminated, giving a higher extinction ratio. Besides, the reflection to in port and leakage to add port can be dramatically suppressed. PS means a phase shifter.

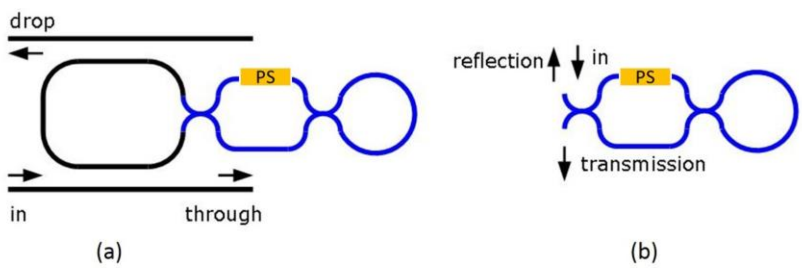

Fig. 2. (a) Schematic of our device and (b) the reflector, respectively. PS refers to a phase shifter.

References

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[2] Werquin, Sam, Steven Verstuyft, and Peter Bienstman. "Integrated interferometric approach to solve microring resonance splitting in biosensor applications." Optics express **21**, 16955-16963 (2013).