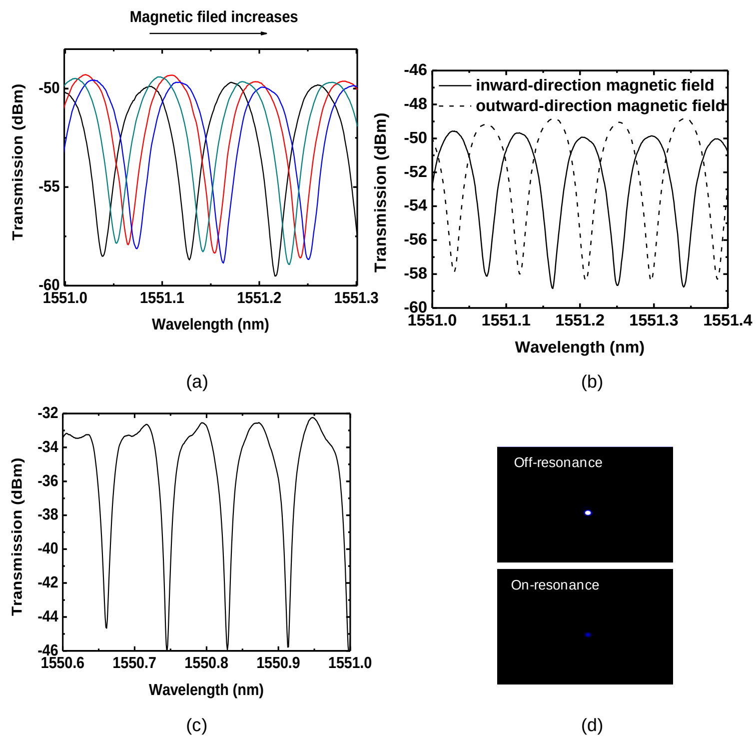

Fig. 5. (a) Transmission spectra of the ring isolator with external radial magnetic fields in different directions. (b) Transmission spectrum of the ring resonator before bonding with Ce:YIG. (c) Near field infrared image at the waveguide output facet with different directions of fields at 1551.25 nm.

There are two reasons the isolation ratio of the ring isolator is limited. The first one is that the power coupling ratio from the straight waveguide to the ring resonator is not optimized to the critical coupling region, which has largest extinction ratio. This can be resolved by designing the waveguide-to-ring coupling in the critical coupling region. The other is that the resonator loss increases after bonding Ce:YIG on the ring, and thus the adjacent resonance dips in the spectrum broaden and overlap with each other. The size of the ring can also be further reduced to increase the free spectra range. As a result, the overlap of the two adjacent resonance dips can be avoided and thus the isolation ratio of the ring isolator won't be cut-off.

4. Conclusions

In summary, we demonstrated the first nonreciprocal ring resonator by bonding Ce:YIG, on top of a silicon ring resonator. The nonreciprocal ring resonator can be used as a ring isolator, which has the advantages of miniaturization and integration with other optoelectronic devices, especially with semiconductor lasers. A 9-dB isolation ratio is achieved in 1550 nm regime and it can be further improved by proper design of waveguide-to-ring power coupling ratio in the critical coupling regime.

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