Tunable Coupled-Resonator-Induced-Transparency in Cascaded Self-Coupled Optical Waveguide (SCOW) Resonators

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Abstract: We experimentally demonstrate self-coupled optical waveguide (SCOW) resonators. Coupled-resonator-induced-transparency (CRIT) is observed in cascaded SCOW resonators. The CRIT can be tuned by thermally tuning the inter-cavity connection waveguide.
OCIS codes: (230.5750) Resonators; (200.4555) Coupled resonators; (230.3120) Integrated optical devices

Recent theoretical analyses have revealed that the phenomenon analogous to electromagnetically induced transparency (EIT) in atomic systems can be observed in various resonator systems, such as in cascaded one-ring-one-bus and mutually coupled microspheres [1]. The CRIT is characterized by the linear phase response and a narrow transparency window in the transmission spectra. The CRIT can be used to produce various functions, including optical filtering, buffering, switching, and biosensing.

Recently, we proposed and experimentally demonstrated novel self-coupled optical waveguide (SCOW) resonators [2, 3], which can work as reconfigurable optical filters and delay lines. Here, we experimentally investigate the CRIT and its tunability in cascaded SCOW resonators.

Fig. 1 (a)-(c) show the scanning electron microscopy (SEM) images of the fabricated single passive SCOW resonator, passive and thermally tunable cascaded SCOW resonators, respectively. The phase shifter is composed of lateral p-i-p junction, where the intrinsic region has a high resistivity and works as a micro-heater. Fig. 1 (d)-(f) show the corresponding transmission spectra. The transmission spectrum of the cascaded SCOW resonators exhibits a CRIT resonance with 0.054nm a wide transparency peak in a 1.6 nm wide opaque valley. In order to explore how the CRIT resonance changes with the inter-cavity phase, we measured the CRIT spectrum change under various electric currents as shown in Fig. 1(f). It can be seen that with the increment of current, the broad opaque valley only slightly shifts, while the CRIT resonance peak experiences an obvious redshift.

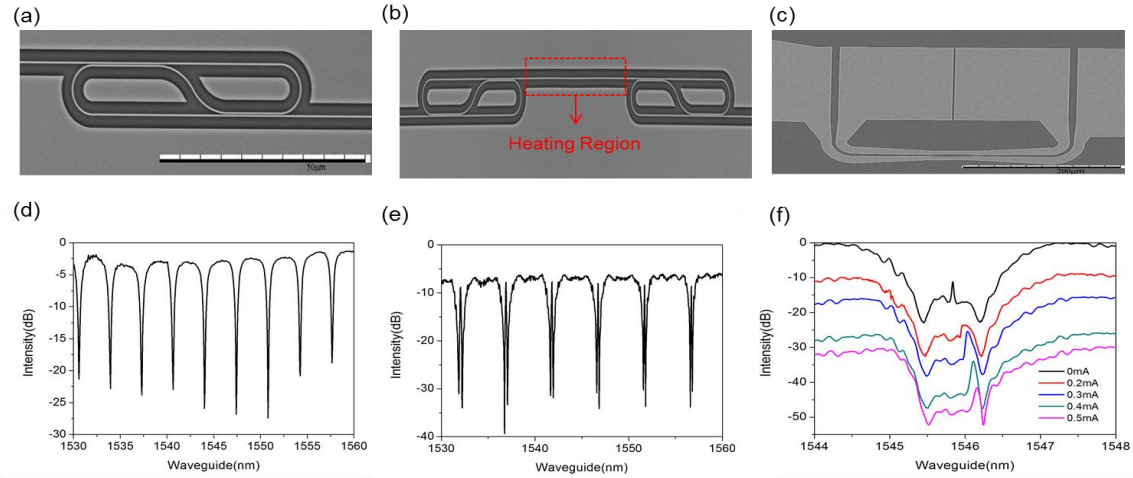

Fig. 1 (a)-(c) SEM images of (a) the single SCOW resonator, (b) the cascaded SCOW resonators, and (c) the cascaded SCOW resonators with thermal electrodes. (d)-(e) Measured transmission spectra of (d) the single SCOW resonator, (e) the cascaded SCOW resonators, and (f) CRIT spectra under various electric currents from 0 to 0.5 mA (the curves are vertically shifted for clarity).

References

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