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Dual-Band Filtering Using a Single Device

Abstract

We demonstrate a multimode integrated Bragg grating allowing **dual-band filtering** in the 1.5-1.6 μ*m* region. **Bandwidths of 4.4 and 7.5 nm** with a **band separation $\Delta\lambda$ of 42 nm** are achieved.

Purpose

- SOI platform promising for keeping up with **large data traffic increase**.
- **Dual-band filters** find use in telecom. (dual-band WDM) [1].
- Demonstrated: multimode microdisk resonators [2] (narrow BW, small FSR).

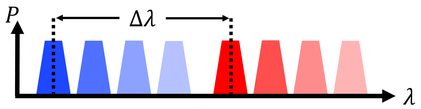


Fig. 1

- Goal: **Dual broadband** filtering ∈ [1.5, 1.6] μm.

Design

- Multimode strip waveguide (**3 TE modes considered**).
- Sidewall **corrugation-enabled** Bragg Grating.
- Coupled-mode theory predicts **mode inter-coupling** [4]:

$$\kappa_{mn} = \frac{\omega}{4}\iint \varphi_m^*(x,y)\,\Delta\mathcal{E}(x,y)\,\varphi_n(x,y)\,dydx \qquad \text{(Eq. 1)}$$

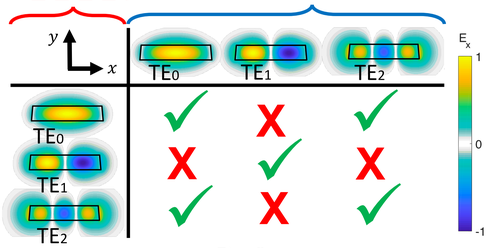
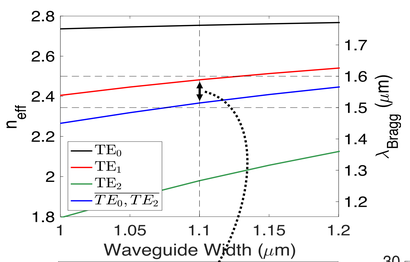


Fig. 2

- **Phase-matching condition** [6]:



- WG design: 1.1 μm.
- Band 1: TE_0-TE_2
- Band 2: TE_1-TE_1

$$\lambda_1 < \lambda_2$$
$$BW_1 < BW_2$$

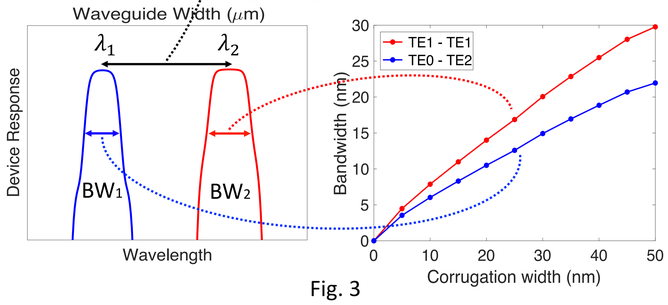
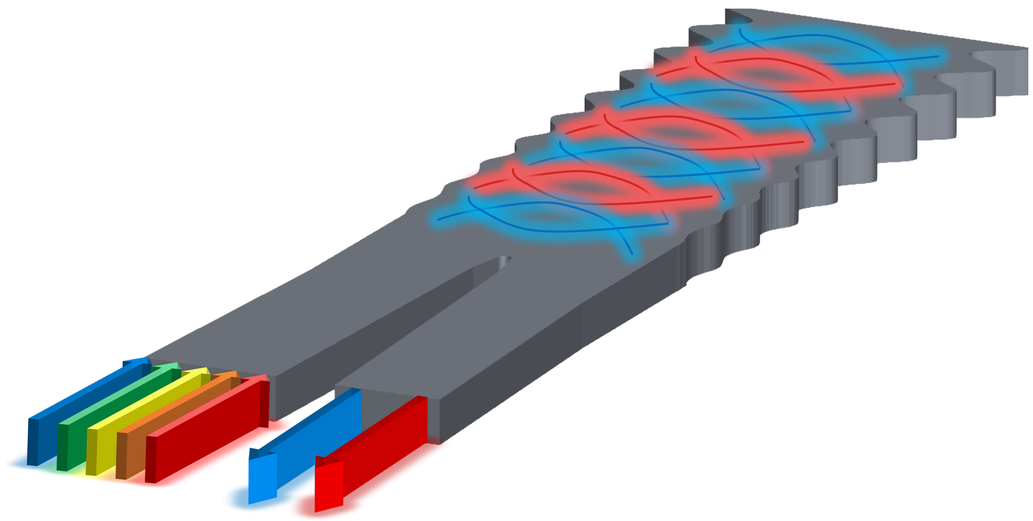


Fig. 3



Read the paper for more information!

- Asymmetric Y-branch:
  - mode converter, band loss compensator.
  - $[w_1, w_2] = [600, 475]$ nm $\Longrightarrow$ **equal loss for both bands** (~12 dB).

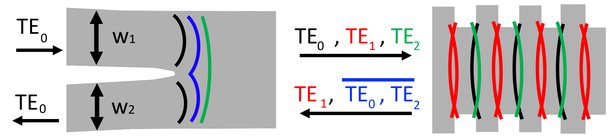


Fig. 4

Fabrication

- Advanced Micro Foundry **(AMF).**
- 193-nm deep UV litho. Process.
- Apodization constant: 12.
- Corrugations:
  - 30-nm designed, 10-nm fabbed.
- Wafer non-uniformity: $\Longrightarrow$ center wavelength shifts.
- Litho. smoothing: $\Longrightarrow$ narrower bandwidths.

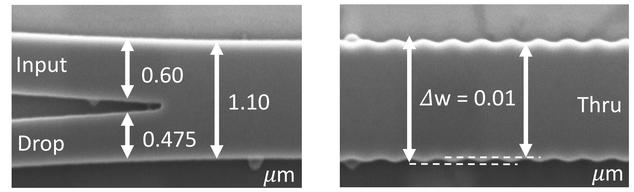


Fig. 5

Results

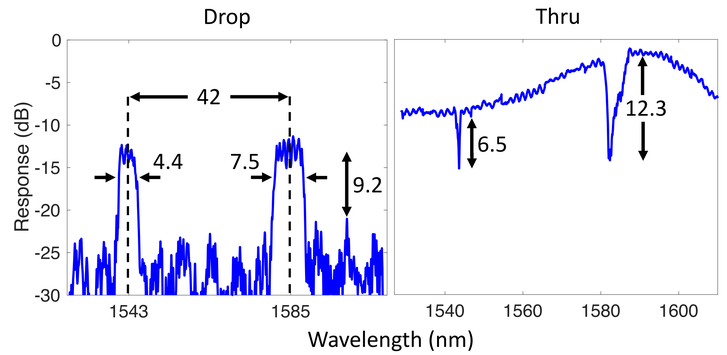


Fig. 6

Conclusion

- Demonstrated **dual-band optical filtering in a single device**.
- Reflection bands **in target region**.
- suitable for **dual-band CWDM**.
- **Bands of equal heights.**

References

1. Iridan. Cwdm dual band, 2019.
2. Qingzhong Huang et al., *Optics letters*,v36(23):4494–4496, 2011.
3. Jonathan St-Yves et al., *Optics letters*, 40(23):5471–5474, 2015.
4. Amnon Yariv and Pocji Yeh, Oxford Univ., 2006.
5. Huiye Qiu et al., *J. Lightw. Technol.*, 35(9):1705–1709, 2017.
6. Toru Mizunami et al., *J. Lightw. Technol.*, 18(2):230–235, 2000.
7. Dominique Charron and Wei Shi, *CLEO Conf.*, JTh2A–44. OSA, 2019.