Defect Grating Simulations: Perturbations with AFM-like Tips

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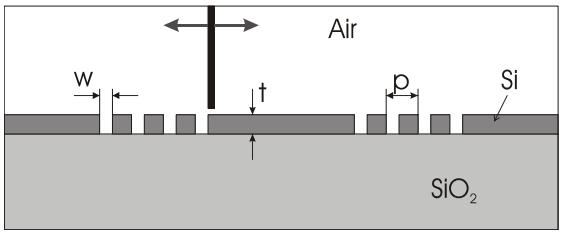

Fig. 1 *Silicon on Insulator defect grating structure under consideration. Refractive indices: SiO_2 – 1.45, Si – 3.4, Air – 1.0, Si_3N_4 – 2.0. Grating period* p *= 380 nm; air hole width* w *= 150 nm; waveguide thickness* t *= 220 nm.*

This paper shows QUEP [1] simulations on a defect grating in the silicon on insulator waveguide structure of Fig. 1, consisting of four periods on either side of a four period defect. The spectrum of the unperturbed structure is shown in Fig. 2.

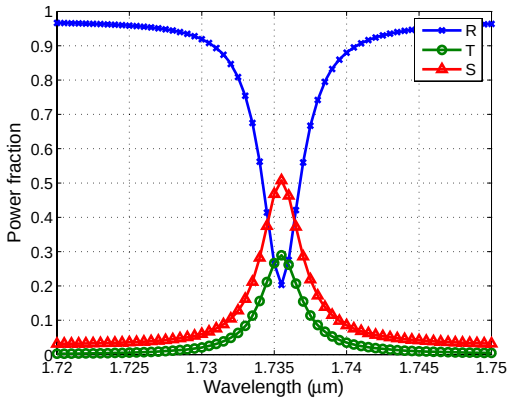

Fig. 2 *Modal reflection (**R**), modal transmission (**T**), and scattered power (**S**) spectra*

While tuning the wavelength to be slightly off-resonance (1.734 μm), a thin (40 nm wide) tip made of either silicon nitride or silicon is scanned across the surface of the waveguide at a height of 10 nm. This perturbs the fields in the grating, moving and possibly deforming the spectrum of the resonance.

In Fig. 3, R, T, and S are shown as a function of the silicon nitride tip position. Using the spectrum, one can obtain the estimated wavelength shift of the resonance.

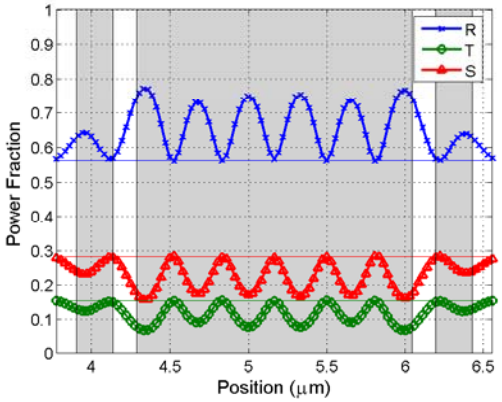

Fig. 3 *Powers as a function of nitride tip location*

Fig. 4 shows that the correlation between the local field intensity at the tip end and the wavelength shift is very good, confirming the experiments described in [2].

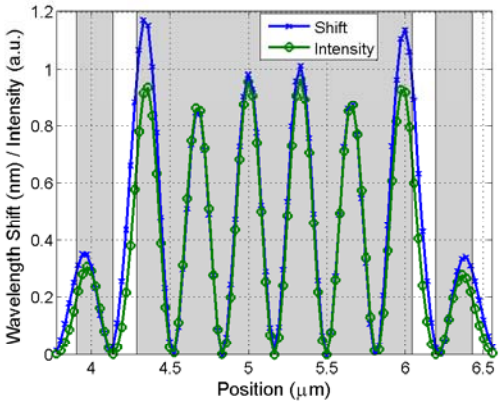

Fig. 4 *Estimated wavelength shift and optical intensity at the end of the tip*

For a silicon tip, similar results are obtained, but the spectral deformation is higher.

References

[1] M. Hammer, Optics Communications **235** (4-6), 285-303 (2004)
[2] W. Hopman et al, Optics express **14**, No. 19 (2006)