7. Conclusion

We have presented a theoretical analysis of guided resonances in PCS structures for biosensing. We discuss the differences between TE-like and TM-like modes, and their implications in bulk spectral sensitivity and resonance quality factors. We have reviewed the underlying physics and the engineering aspects in selecting a symmetric or asymmetric PCS topology. It is demonstrated that PCS biosensors suspended over a substrate (symmetric designs) can display roughly a three-fold increase in bulk sensitivity over slab-on substrate architectures (asymmetric designs) for TM-like guided resonances. Furthermore, we report that TM-like guided resonances have a stronger vertical field penetration than TE-like guided resonances, which contributes to their significantly higher bulk index sensitivity and to their potential to overcome major fabrication-related challenges in realizing high quality factors in large area PCS sensors. PCS sensors can have similar (TE-like) or smaller (TM-like) detection limits compared to existing optical biosensing techniques, with the added advantages of sensitivity optimization based on mode selection, and straight-forward sensor integration with microfluidics and optical readout by free space beams. Finally, analysis of modal field distributions suggest that TE-like resonance sensors may be suited for protein and biomolecule detection while TM-like resonance sensors are more meaningful for use to sense cells and large analytes.

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