5. Conclusion

In this paper, we have described a new type of RI sensors based on an FBG FP cavity embedded with a microchannel. Microchannels with different sizes have been realized using fs laser inscription assisted chemical etching and the narrowest width of only 1.2μm has been demonstrated. Two FBG FP structures with a relatively narrow (5μm) and broad (35μm) channel were used for RI sensing characterization, showing a linear RI response with sensitivities of 1.1nm/RIU and 9nm/RIU, respectively. The broader channel device gives considerable high loss and can work only in a limited RI range from 1.43 to 1.49. In contrast, the narrow channel device gives a much larger RI measurement range from 1.3 to 1.7. We also performed a theoretical simulation by employing transfer matrix technique and the simulation results are in excellent agreement with experimental ones. More importantly, the modeling has revealed the influence of the device parameters and structure on loss and RI sensitivity, which provides a good design tool for optimized sensors. Overall, the revealed linear RI response with significantly larger detection range and high sensitivity of the microchannel FBG FP sensors are of great advantages over fiber grating based refractometers, as the latter all have a nonlinear RI response with detection range limited to fiber core index only to 1.44. With these remarkable advantages, microchannel FBG FP structures could be further developed into high performance bio/chemical/environmental sensors.

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