

Enhanced Bragg Resonances in Small Period Long Period Fiber Grating Fabricated with Femtosecond Laser Line by Line Technique

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Background

Featured by a much smaller grating period (25 μm), small period long period fiber grating (SP-LPFG) has a high sensitivity to surrounding refractive index (SRI) and, thanks to the existence of high order Bragg resonance, can measure the temperature simultaneously [1].

However, the Bragg resonance is very weak (<0.6 dB) in previous reports. In this work, SP-LPFG is fabricated by femtosecond laser line by line (LbL) technique [2]. High order Bragg resonances are significantly enhanced from ~ 0.6 dB to ~ 11 dB. Moreover, coupling from core mode to both forward-propagating cladding modes (FPCMs) and backward-propagating cladding modes (BPCMs) is also allowed.

Experiments

In our experiment, a section of striped fiber is fixed on the three-dimension motor stage (as shown schematically in Fig. 1a), and femtosecond laser (520 nm, 350fs, 200 kHz) beam is tightly focused into the fiber with an objective lens (63 \times).

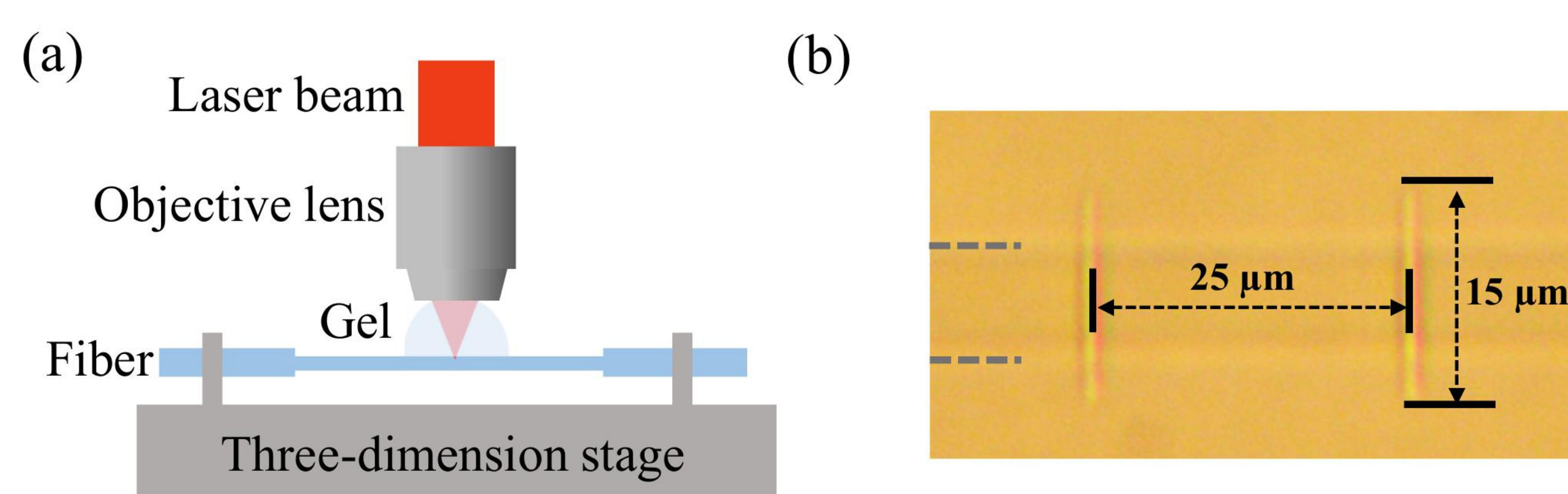


Fig. 1 (a) Schematic of the grating fabrication setup, (b) microscope view of the fabricated grating.

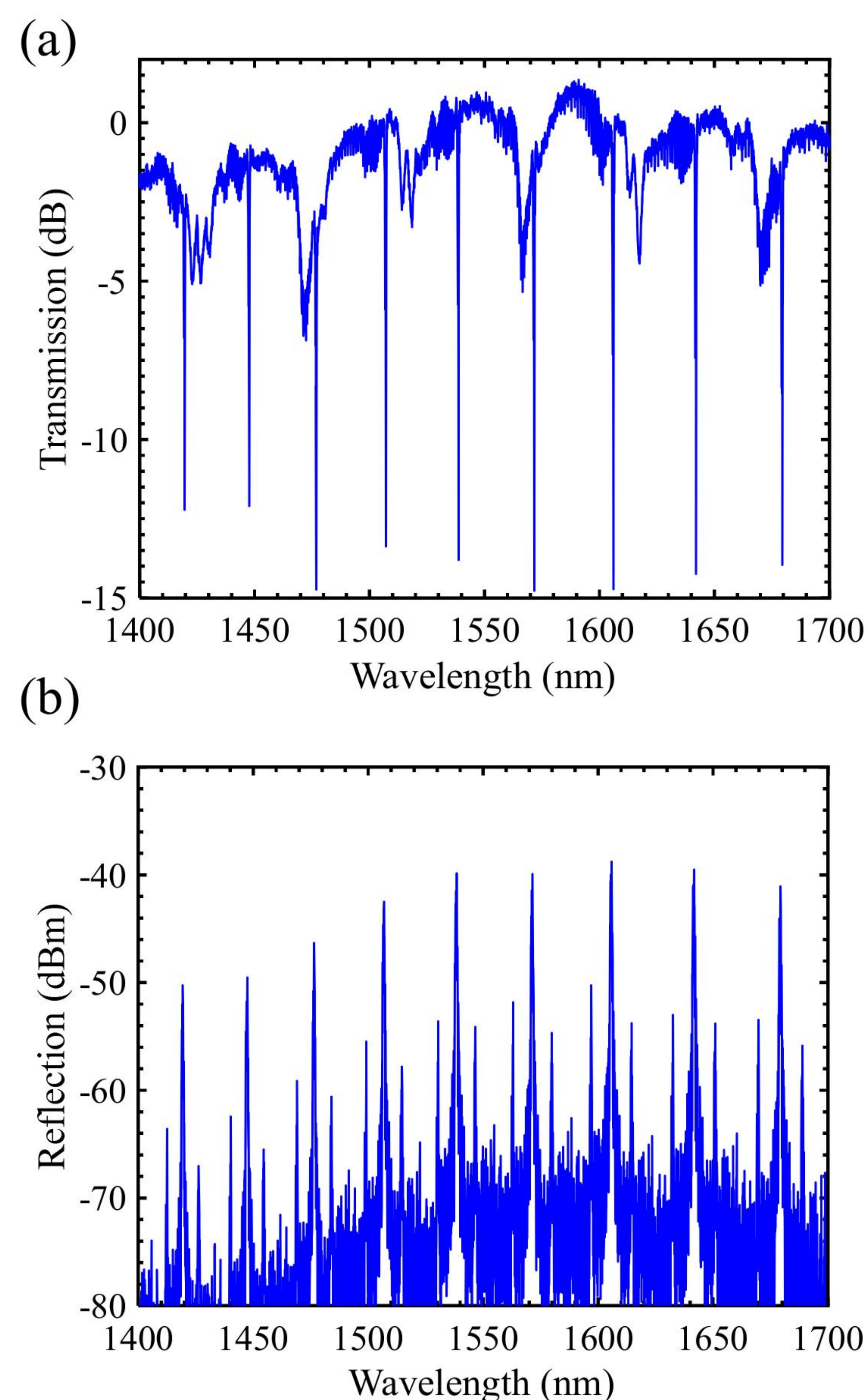


Fig. 2 (a) Transmission and (b) reflection spectrum of the fabricated grating in air. The Bragg resonances in Fig. 2 correspond to the 43rd to 51st order Bragg resonances (from long to short wavelength side).

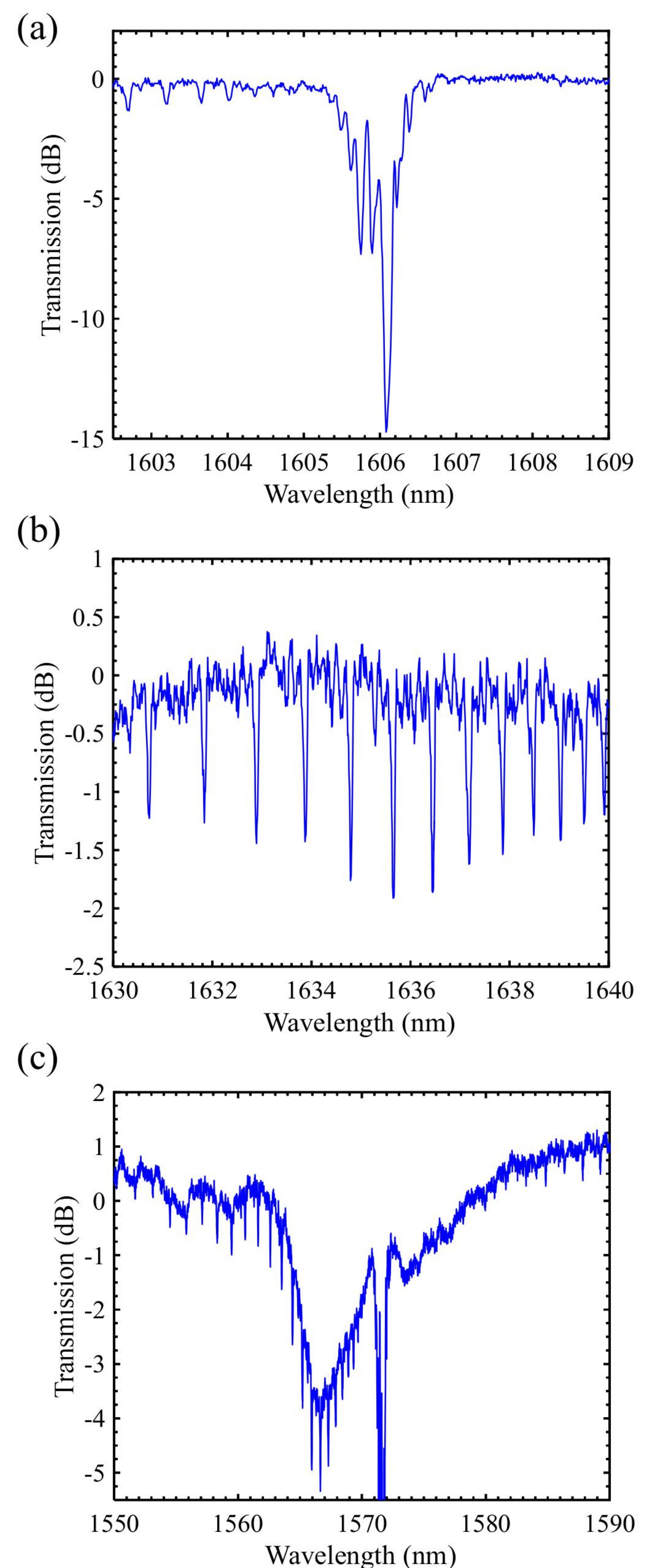


Fig. 3 Regional spectrum of (a) Bragg resonance, (b) BPCM resonances, and (c) overlap of BPCM and FPCM resonances. The three types of resonances are useful for dual- or multi-parameter sensing applications.

Summary

We demonstrate the fabrication of SP-LPFG with femtosecond laser LbL technique. The strength of Bragg resonance is significantly enhanced in LbL inscribed SP-LPFG, and resonances of BPCM are also observed, which present comb-like spectrum similar to that of TFBG [3].

References

1. F. Shen, et al. Opt. Lett., vol. 42, Jan. 2017, pp. 199-202.
2. K. Zhou, et al. IEEE Photon. Technol. Lett., vol. 22, Aug. 2010, pp. 1190-1192.
3. J. Albert, et al. Laser Photonics Rev., vol. 7, Jan. 2013, pp. 83-108.