A high stability microfiber Sagnac loop refractive index sensor

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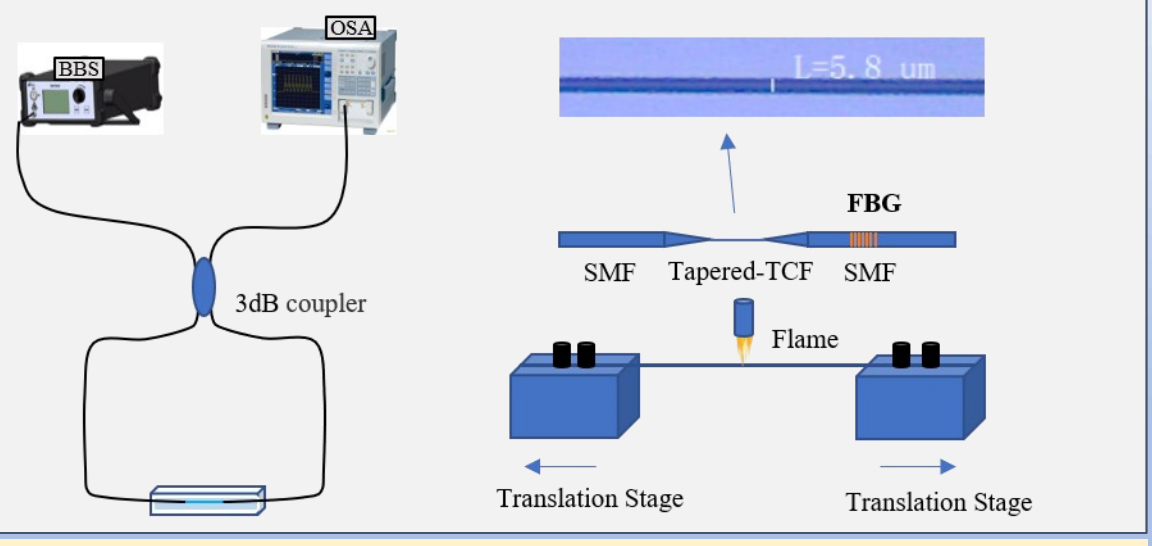
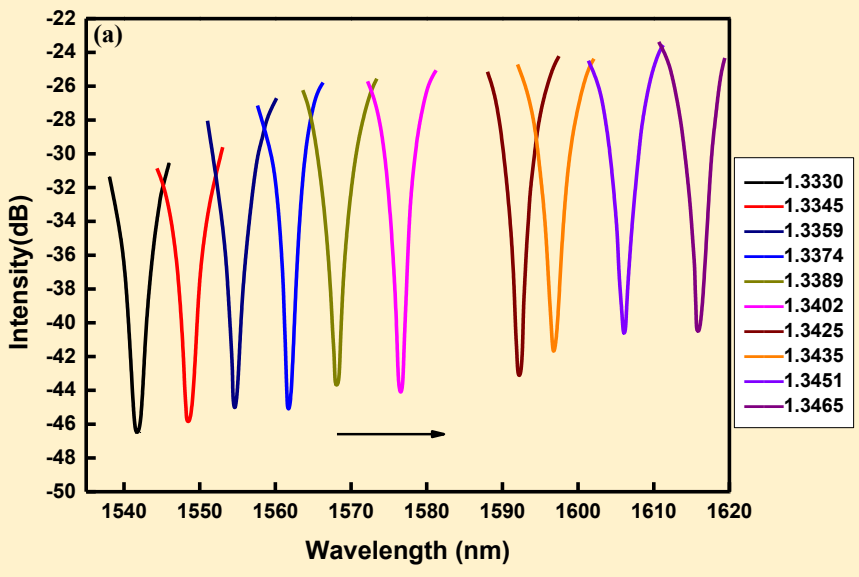
Abstract

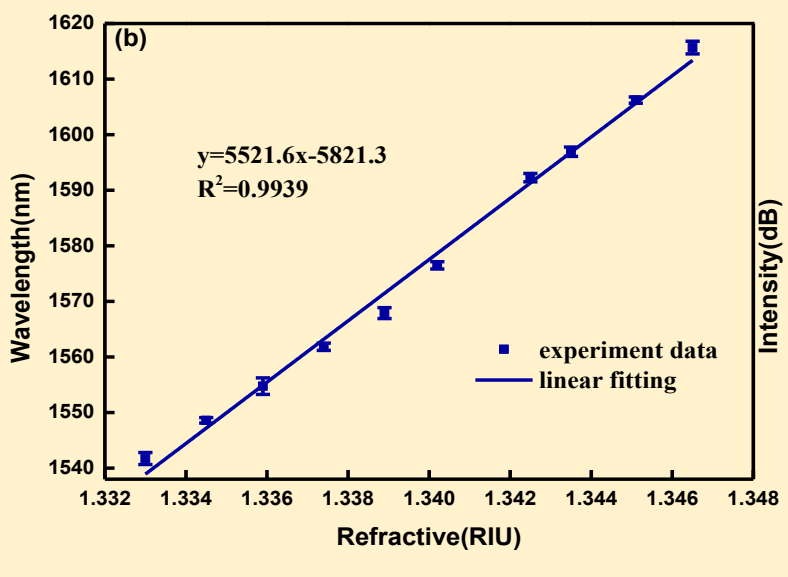
A Sagnac loop liquid refractive index sensor is proposed based on SMF-Tapered TCF-SMF（STS）and FBG. In the refractive index range of 1.333-1.3465 and 1.3515-1.363, the sensitivity is 5521.6nm/RIU and 7173.8nm/RIU, respectively. By cascading FBG,the random fluctuation of wavelength is reduced from ±0.862nm to 0.004nm. It can effectively filter out part of the cladding mode and improve the stability of the sensor.

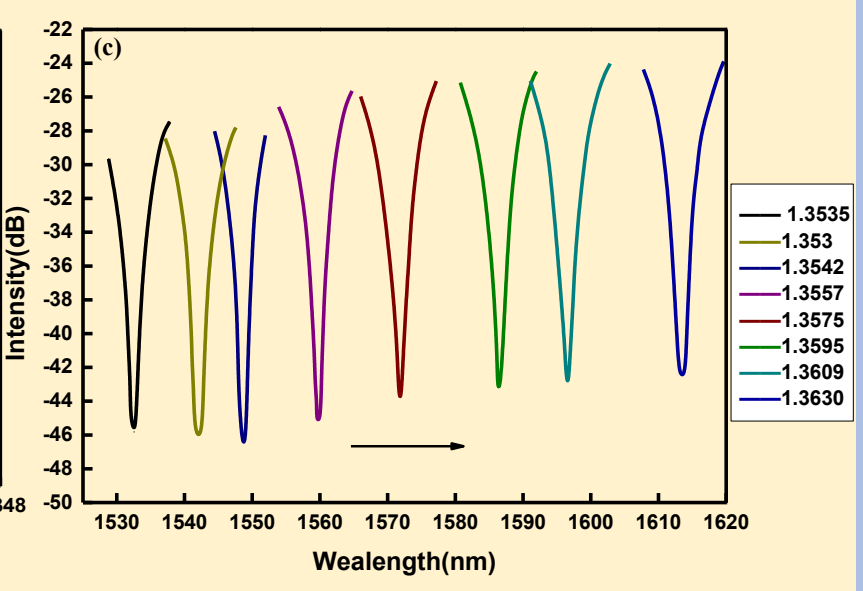
Sensor fabrication and experimental device setup

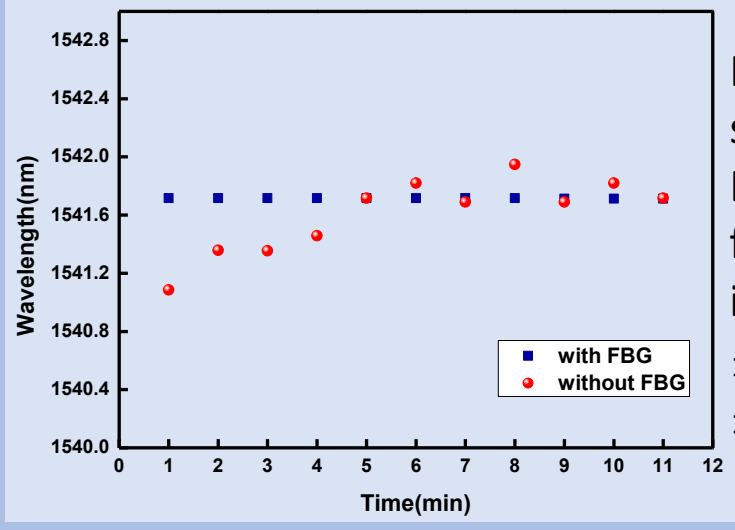


Experimental results

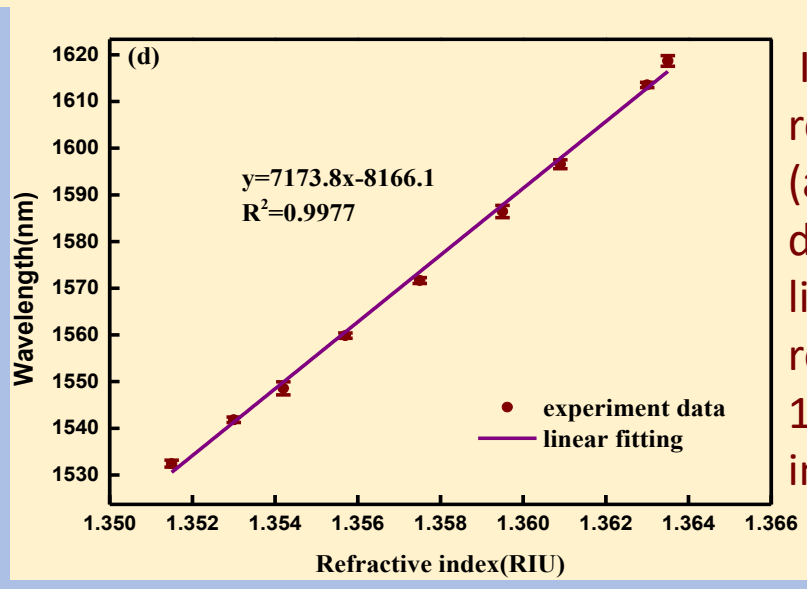






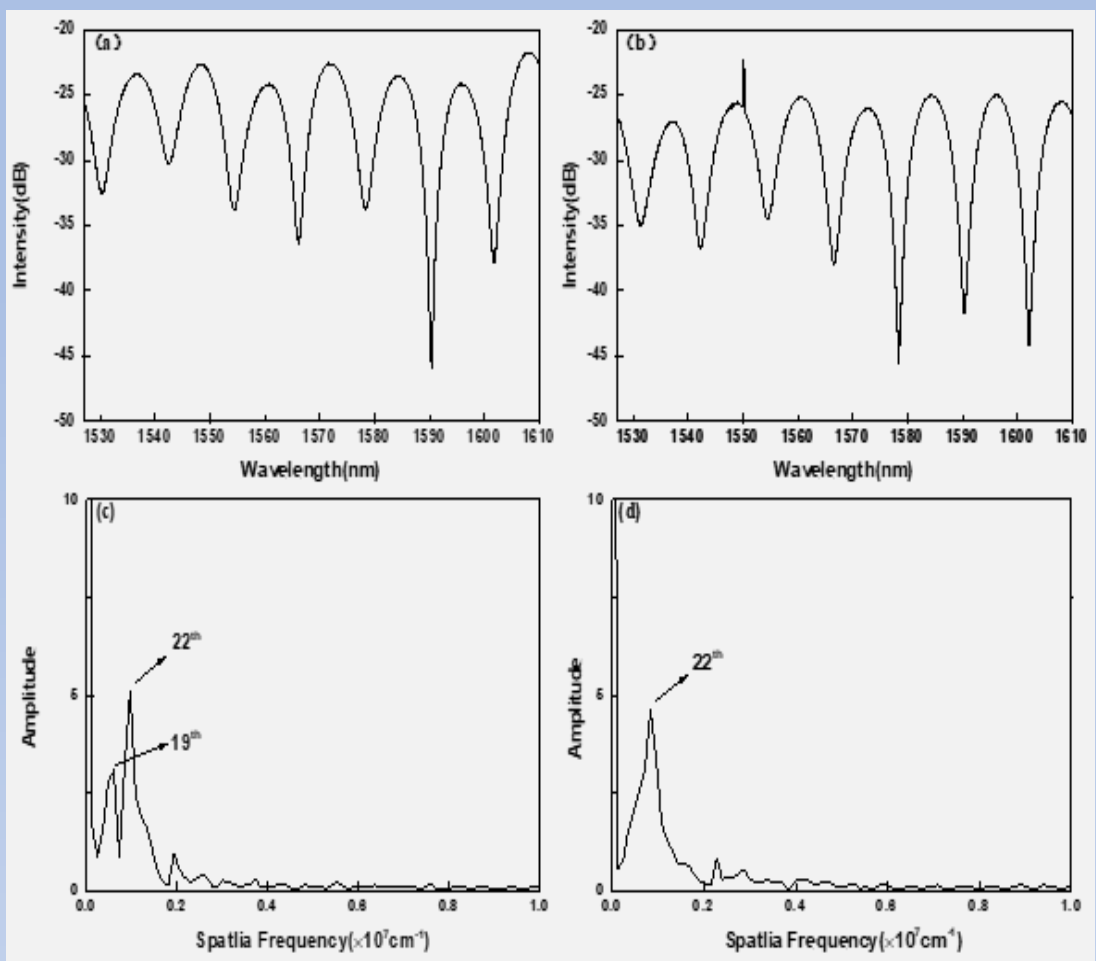


For the sensor structure with FBG access, The fluctuation range is reduced from ±0.862nm to ±0.004nm



In the1.333-1.3465 refractive index range (a)and(b) is spectral drift diagram and wavelength linear fitting diagram, respectively .(c)and(d) is the 1.3515-1.363 refractive index range

Theoretical simulation



Conclusions

1. Through the Fourier transform of the experimental data of the cascaded fiber grating and the non-cascaded fiber grating, fiber grating can effectively suppress some cladding modes in the microfiber Saganac loop.

2.In terms of experiment, The experimental results show that the sensitivity is 5521.6nm/RIU and 7173.8nm/RIU in the refractive index range of 1.333-1.3465 and 1.3515-1.363, respectively, and the linearity is more than 99%.

3. For the sensor structure with FBG access, The fluctuation range is reduced from ±0.862nm to ±0.004nm, which is smaller than the measurement resolution of the spectrometer.

It can be seen that access to FBG frequency selection is an effective method to improve the stability of microfiber Sagnac loop interferometers.

Output spectrum of Sagnac loop optical fiber.(a) with FBG. (b) without FBG. Spatial spectrum diagram of microfiber Sagnac loop (c) with FBG.(d)without FBG. Fiber grating can effectively suppress some cladding modes in the microfiber Saganac loop