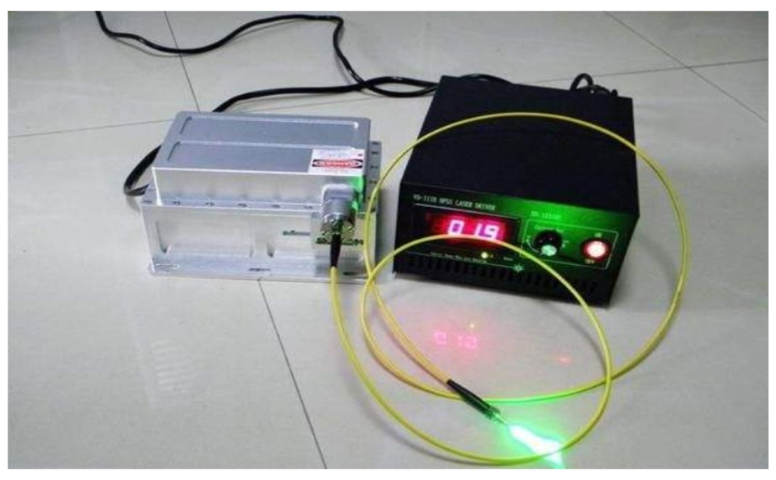
Random grating-array-based tunable random fiber laser with a full-open cavity

Bing Lv, Wentao Zhang*, Wenzhu Huang, and Fang Li
*Email: zhangwt@semi.ac.cn

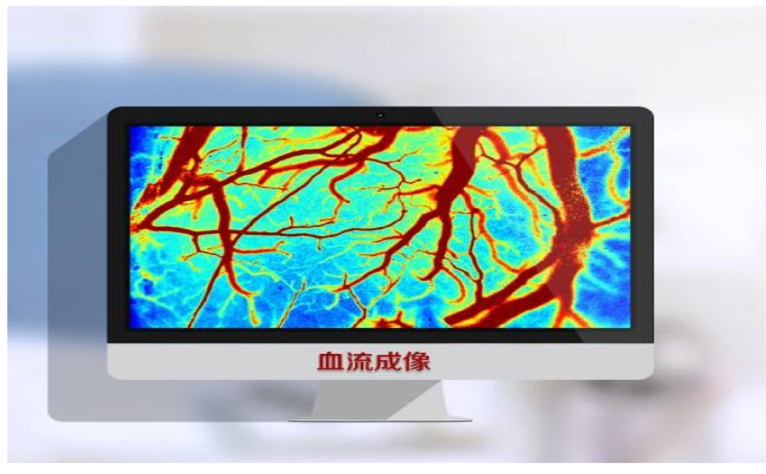
Introduction

- Tunable lasers have many applications, such as laser spectroscopy, industrial manufacturing, medicine sensing and national defense.
- Tunable random fiber laser (TRFL) provides a new option.



Laser Spectroscopy

Industrial Manufacturing

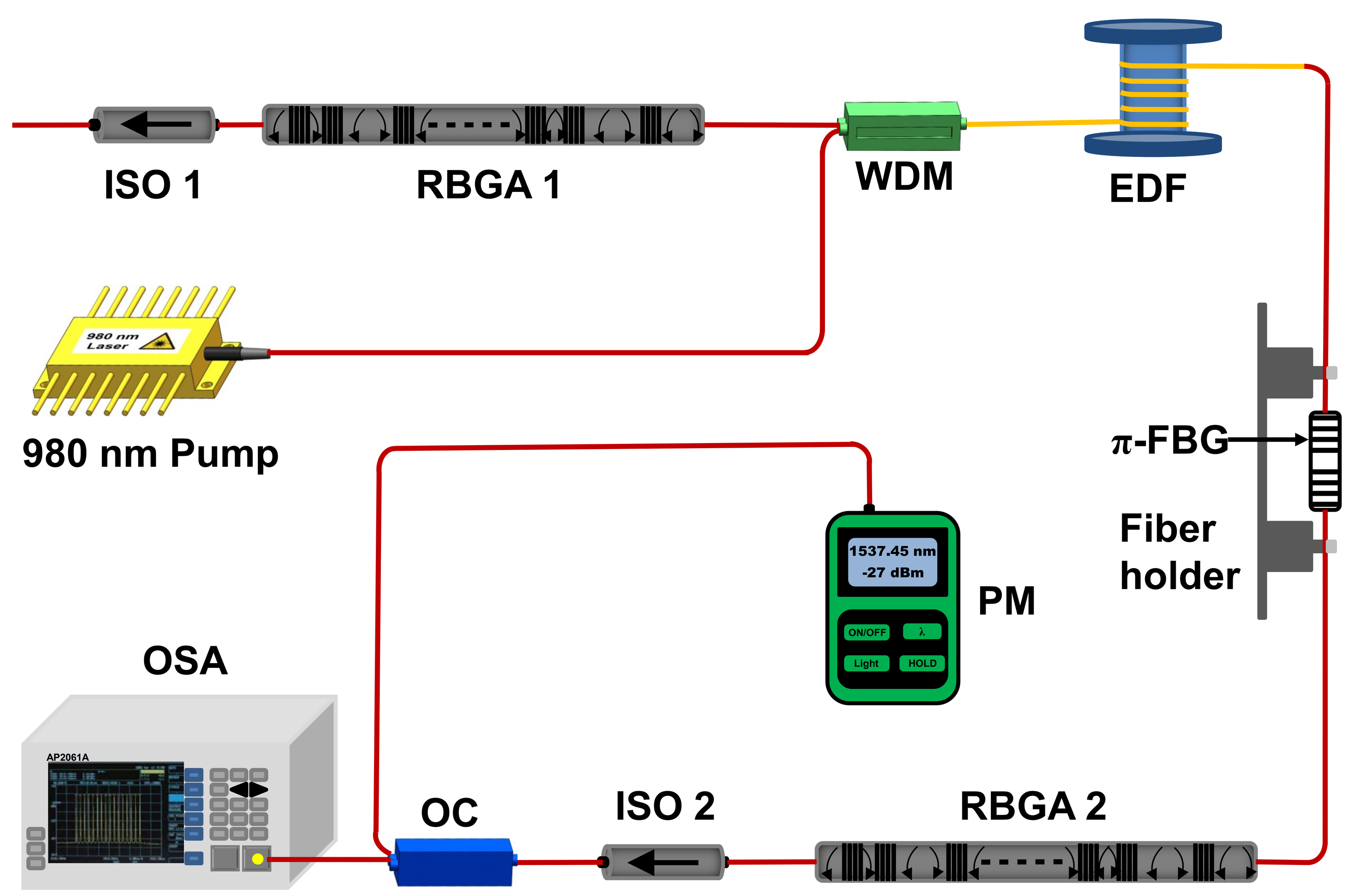


Medicine Sensing

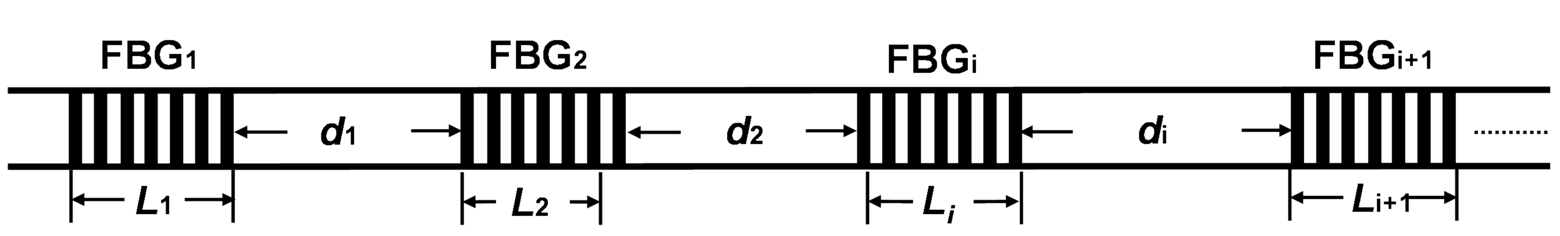
National Defense

Designed structure of TRFL

- Two random Bragg grating arrays (RBGAs) form a compact full-open-cavity structure, which provides feedback and reduces the lasing threshold due to strong efficiency. A 4-m-long erbium-doped fiber is pumped by a 980 nm laser through a 980/1550 nm wavelength division multiplexer. The π-FBG is between two translation stages and adjusted by applying axial strain.



Parameters of RBGA



Weak FBGS					Total Length
Number(i)	Wavelength	Length(L_i)	Reflection	Separations (d_i)	168 cm
30	~1537.48 nm	3 mm	~4%	3~8 cm	

Principle of light location

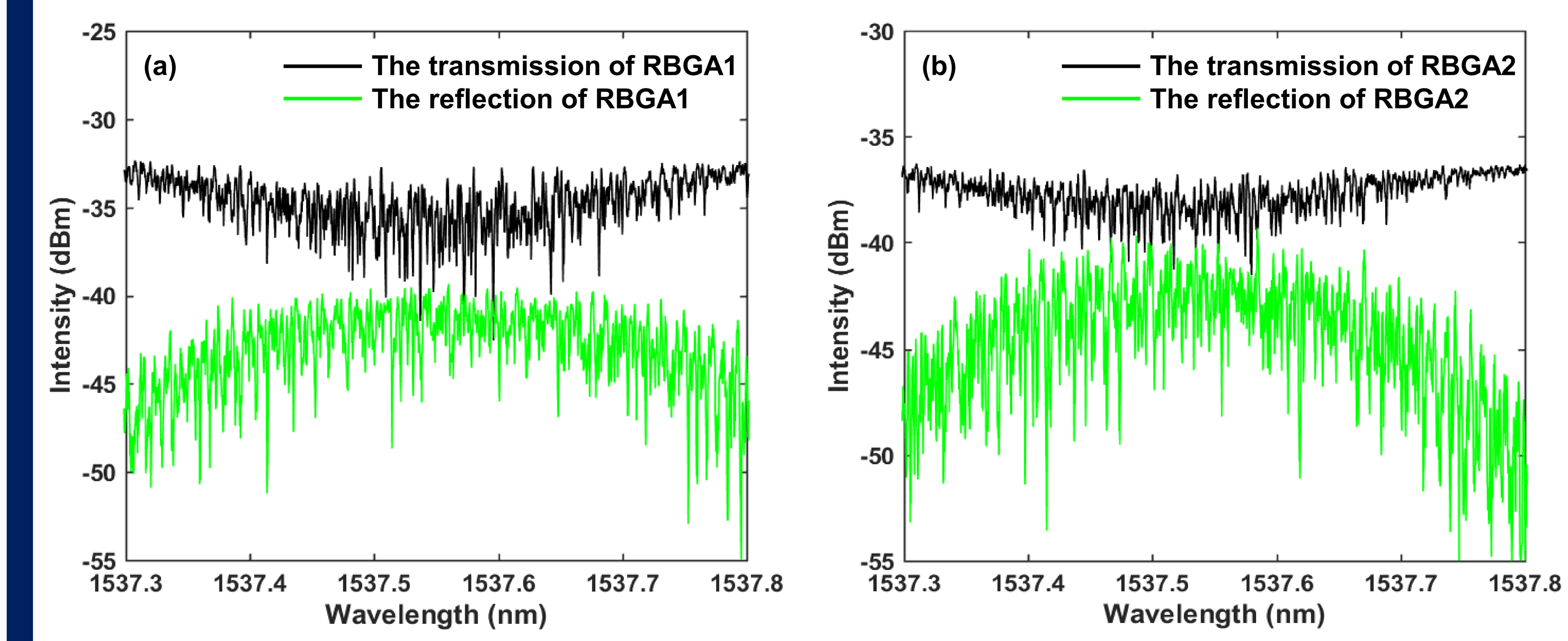
- The random lasing can be generated as long as the light localization length is much shorter than that of the random medium. The light localization length can be estimated:

$$T(L) \approx \exp\left(\frac{-0.5L}{\xi}\right)$$

- where T is the average transmittance of RBGA, L is the length of RBGA (random medium), and is ξ the light localization length.

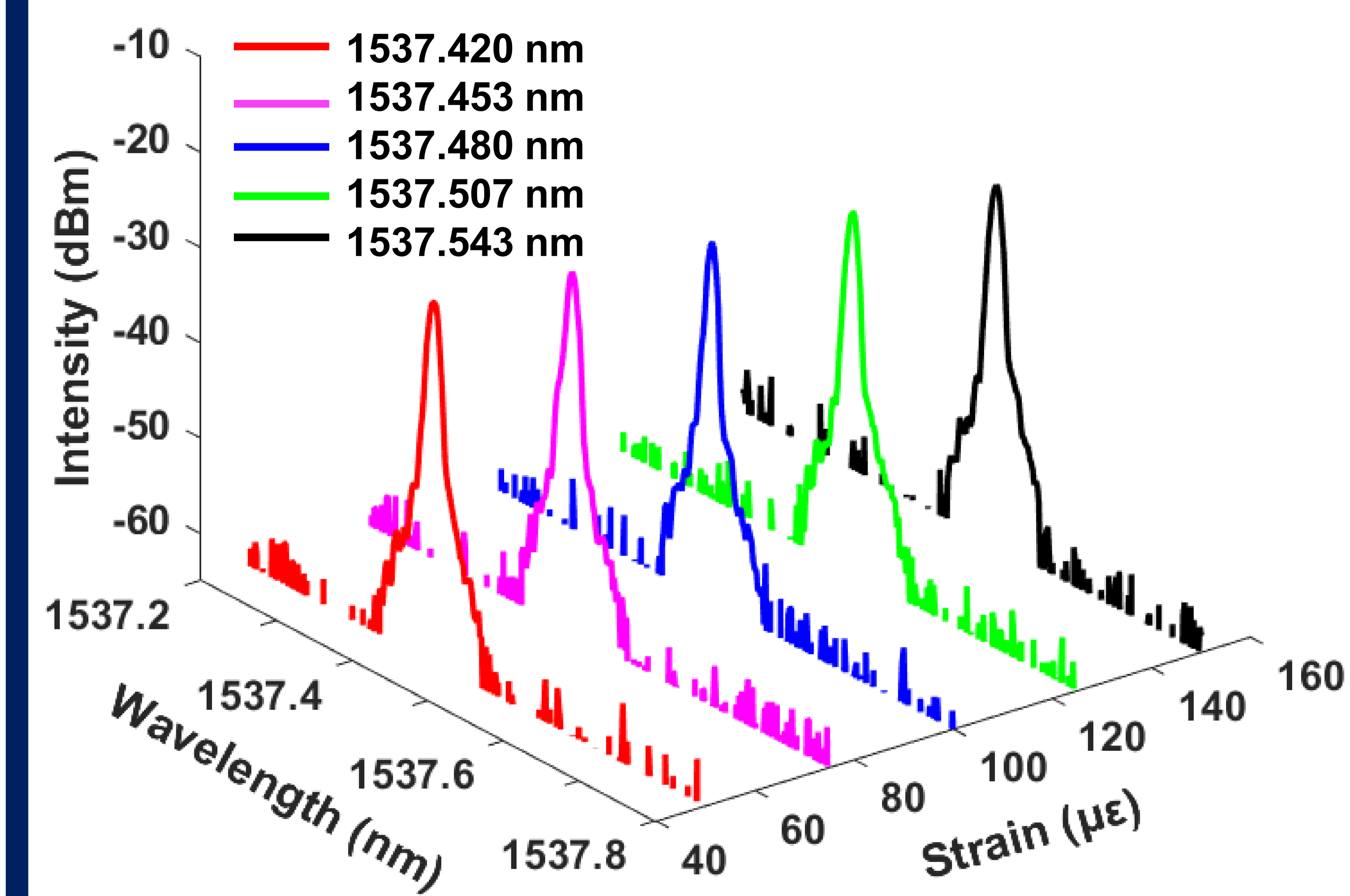
Measured spectra of RBGAs

- The RBGA1 has a 3-dB bandwidth of 0.39 nm and a center wavelength of 1537.484 nm. The RBGA2 has a 3-dB bandwidth of 0.35 nm and a center wavelength of 1537.488 nm. The transmittance, T, of two RBGAs are about 13%, about 25%, respectively.

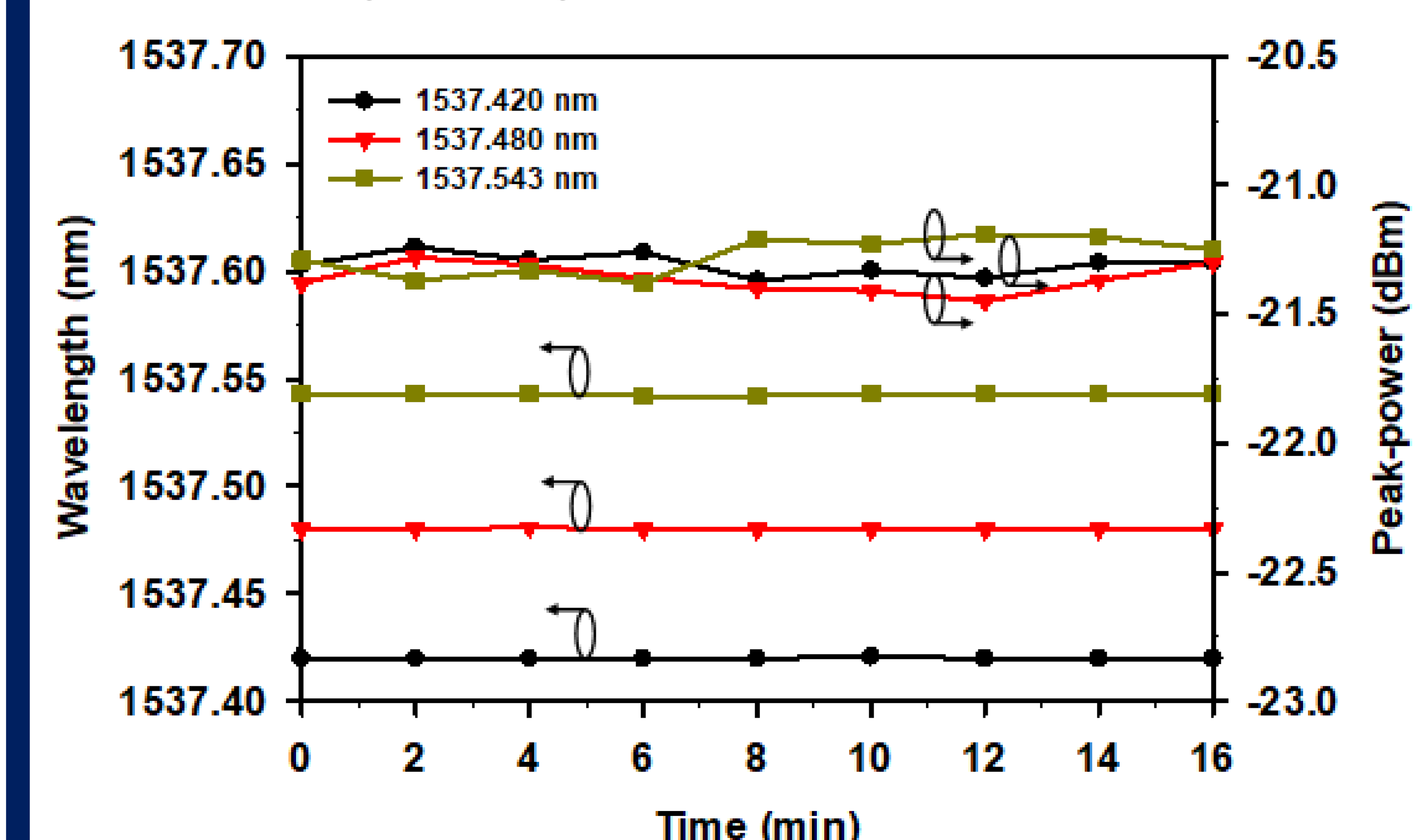


Lasing spectra and stability of TRFL

- The lasing wavelengths at 1537.420 nm, 1537.453 nm, 1537.480 nm, 1537.507 nm, and 1537.543 nm are obtained when the axial strain are 50 με, 75 με, 100 με, 125 με and 150 με respectively.



- The maximum peak-power fluctuation is less than 0.19 dB. The maximum variation of wavelength is less than 1 pm for three selected lasing wavelengths.



Conclusion

- Two RBGAs form a full-open-cavity, which can provide high random feedback efficiency and compact structure.
- The designed π-FBG can select stable lasing spectrum by applying different axial strain.
- The proposed TRFL provides a new option for high-resolution optical sensing, coherent communication and so on.

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State Key Laboratory of Transducer Technology
Institute of Semiconductors, Chinese Academy of Sciences