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ストークス光を抑圧した広帯域波長掃引光ファイバパラメトリック発振器
Broadband Swept-Pump Fiber Optical Parametric Oscillator with Stokes Suppression

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1. Introduction

Fiber Optical Parametric Oscillators (FOPOs) are nonlinear devices where the optical gain is based on the four-wave mixing (FWM) process in highly nonlinear fibers (HNLFs) or dispersion shift fibers (DSFs) [1]. Because the gain bandwidth of FOPOs can increase with pump power, a bandwidth of several hundred nanometers can be achieved. Recent research has applied the property as a broadband amplifier or a tunable laser source [2, 3], which are amazing in the field of medical imaging, real-time fiber sensor interrogation and chemical sensing. This paper demonstrates a wavelength-swept source operating in near infrared (NIR) band. By introducing bend-loss low pass filter, we report a nearly 200nm wavelength-swept range from 1300nm to 1500nm. More importantly, the introduced swept source exhibits an order of magnitude increase of the output power if the stimulated Brillouin scattering is well suppressed.

2. Experiment and Results

The experimental setup of the FOPO is shown in Fig. 1. The FOPO consisted of a DSF, a polarization controller (PC), a bend-loss low pass filter, and a 95/5 coupler. The DSF (about 300m) was the parametric gain medium with zero-dispersion wavelength of λ_0=1570 nm and dispersion slope of slope $dD/d\lambda$=0.072 ps/nm^2/km, and nonlinear coefficient of γ=2 /W/km. The low pass filter was made by rotating a SMF-28 fiber, where the bend loss is wavelength dependent. This filter ensures only the anti-Stokes light returns to the DSF through the coupler. The loss property of the filter is shown in Fig. 2. The pump source consists of an external cavity laser which is tunable between 1520 and 1630 with an output power 8dBm. The CW output of the laser was modulated by a MZ modulator with 8 ns pulses. Then the pump pulses were amplified by two EDFAs. The repetition frequency was finely tuned which was matched to the cavity fundamental frequency (641.5KHz). The pump pulses were amplified to an average power about 27dBm. Fig. 3 shows the output spectrum of the wavelength-swept FOPO, which was taken in the peak-hold mode. The pump was swept from 1530-1550nm. Fig. 4 is the spectrum around a specific wavelength (1554 nm) in detail. It can be found that the SBS for the generated light is very strong. If SBS is alleviated, the output power could be increased for an order of magnitude.

3. Conclusion

In summary, we demonstrated a broadband (about 200 nm) swept-wavelength source in NIR band. By utilizing the low pass filter, the output powers were increased by up to a factor of about 10 dB compared with the Ref [2] and [3]. Moreover, much higher output power is expected if we improve the system to suppress SBS, which can approach 10 dBm.

References

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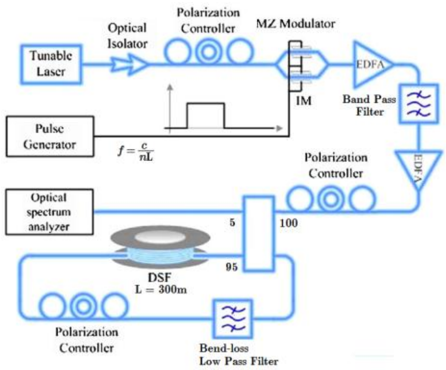

Fig. 1　Experimental setup of wavelength-swept FOPO.

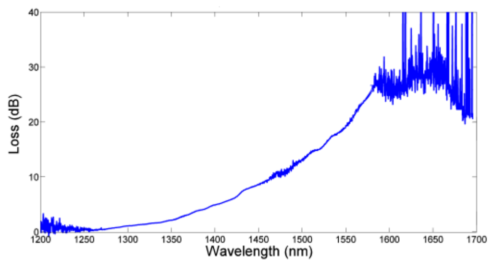

Fig. 2　Transmission property of the low pass filter.

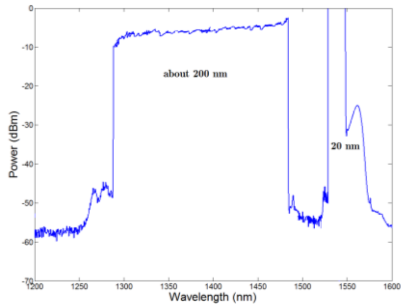

Fig. 3　Optical spectrum at FOPO output.

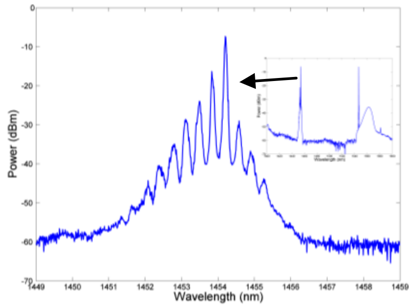

Fig. 4　The spectrum for the output around 1454 nm. The SBS affects the output power strongly.