

Wavelength tunable erbium-doped fiber laser using a Sagnac fiber loop

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Abstract:

A simple configuration to perform wavelength tunability in a figure-of-eight fiber laser is demonstrated in this experiment. We used a 980 nm laser diode to pump the erbium-doped fiber (EDF) to generate the light nearby 1550 nm and an isolator was set in the main cavity to ensure the unidirectional propagation of light. The main laser cavity is coupled with a fiber loop in Sagnac-interferometer structure. By changing the angle of the fiber polarization controller in the Sagnac loop, several multi-wavelength output spectra of the fiber laser were observed. The output wavelength could also be singly and continuously tuned from 1545 nm to 1566 nm with a 10-meter-long EDF, and from 1558 nm to 1574 nm with a 20-meter-long EDF. The Amplified Spontaneous Emission (ASE) spectrum of the EDF was also examined as a function of its length.

Experimental Setup:

We used a 980nm laser diode to pump the erbium-doped fiber(EDF) which serves as the gain medium. The driving current of the pump laser diode was set to be 200mA and the diode laser output power was about 100mW. In this experiment, we use two different length of EDFs (10m and 20m) as the gain medium.

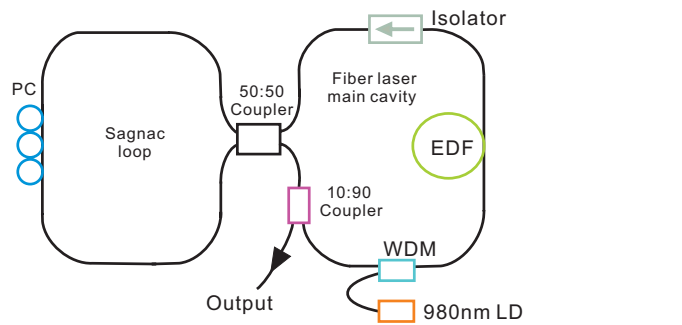


Fig.1. The schematic of a wavelength tunable erbium-doped fiber ring laser: PC, polarization controller; WDM, wavelength division multiplexer; EDF, erbium-doped fiber; LD, laser diode.

Experimental Results:

We have observed several kinds of spectra, such as single wavelength tunable or multiwavelength tunable, when we tune the angle of the polarization controller(PC) in the Sagnac loop.

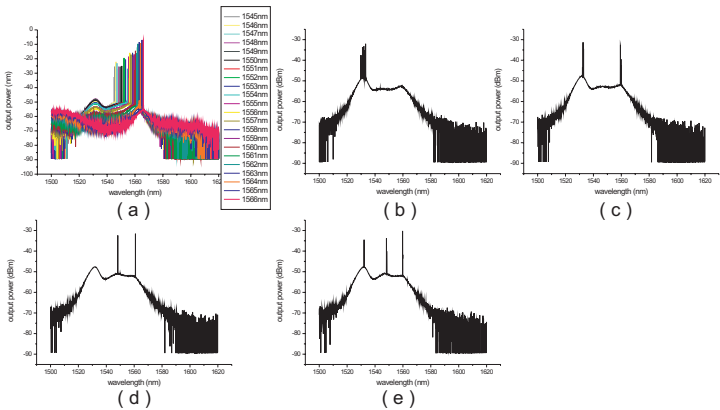


Fig.2. Output spectra of the fiber laser obtained with a 10m EDF. (a)Single wavelength tunable range from 1545nm to 1566nm.(b)Multiwavelength at 1533nm nearby.(c)Double wavelengths exist at 1533nm and 1559nm.(d)Double wavelengths exist at 1548nm and 1560nm.(e)Triple wavelengths exist at 1532nm, 1548nm and 1559nm.

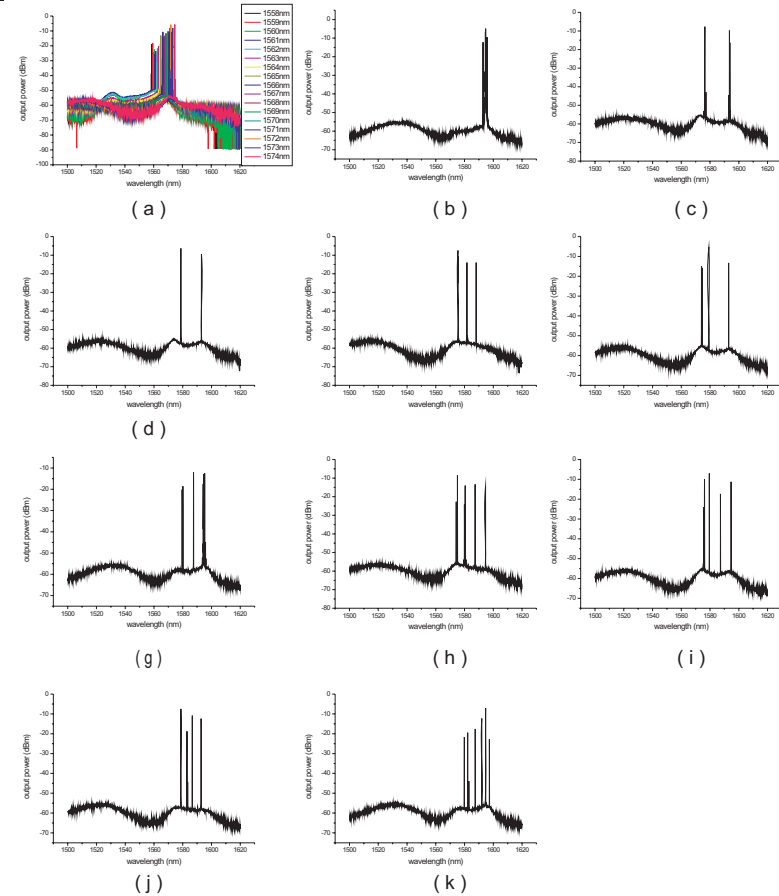


Fig.3. Output spectra of the fiber laser obtained with a 20m EDF. (a)Single wavelength tunable range from 1558nm to 1574nm.(b)Multiwavelength at 1594nm.(c)Double wavelengths exist at 1578nm and 1593nm.(d)Double wavelengths exist at 1578nm and 1593nm.(e)Triple wavelengths exist at 1575nm, 1581nm and 1588nm.(f)Triple wavelengths exist at 1574nm, 1579nm and 1592nm.(g)Triple wavelengths exist at 1580nm, 1587nm and 1594nm.(h)Quadruple wavelengths exist at 1576nm, 1579nm, 1587nm and 1594nm.(i)Quadruple wavelengths exist at 1576nm, 1579nm, 1587nm and 1594nm.(j)Quadruple wavelengths exist at 1578nm, 1582nm, 1586nm and 1592nm.(k)Sextuple wavelengths exist at 1579nm, 1582nm, 1587nm, 1592nm, 1594nm and 1597nm.

The amplified spontaneous emission (ASE) spectrum was also measured to explore the characteristics of the different EDF.



Fig.4. The configuration for the ASE measurement of the EDF.

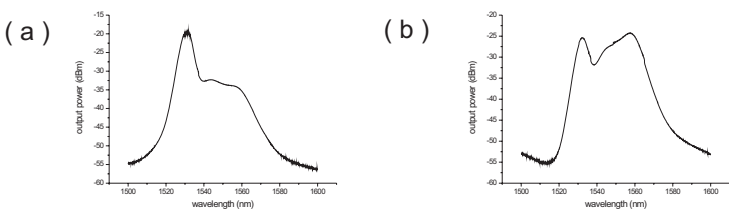


Fig.5. The ASE spectra of the EDFs.(a)10m EDF(b) 20m EDF .

Conclusion:

In this fiber laser experiment, we get some wavelength tunable results about 10m EDF and 20m EDF, and their ASE spectrum distributions.

	10m EDF	20m EDF
Single wavelength tunable range	1545nm to 1566nm	1558nm to 1574nm
Multiwavelength Output types	Double、Triple	Double、Triple、Quadruple、Sextuple
ASE spectrum bandwidth	Narrower	Broader

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