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Multiwavelength Fiber Laser in Four Mode Fiber

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Abstract

Multiwavelength fiber laser is a nonlinear phenomenon that has a great potential for optical communication system. A stable triple-wavelength fiber laser in four mode fiber had been demonstrated experimentally by employing Sagnac filter in a simple close loop laser cavity. The Sagnac loop filter configuration was constructed using a 2 m of polarization maintaining fiber (PMF), a 3 dB coupler and a polarization controller. The laser is able to sustain triple-wavelength laser generation at 13.1 dBm output power of Erbium-Doped Fiber Amplifier (EDFA) as all laser wavelengths produced less than 0.25 nm fluctuation for over 20 minutes of unstoppable lasing operation. This laser configuration also has flexibility to perform single, dual and triple wavelength laser by controlling the EDFA output power.

Keywords : Multi-wavelength fiber laser; Sagnac filter; EDFA; PMF

1. Introduction

Broad applications of multi-wavelength Erbium-doped fiber laser in many fields, such as optical fiber sensing, optical communication system and instrument testing have developed massive attractions and interests due to simple architecture, low insertion loss, low cost [1-6], high power conversion efficiency and low threshold. Various gain media had been utilized, such as Raman amplifier [7], semiconductor optical amplifiers (SOAs) [8, 9], and Erbium-doped fiber amplifiers (EDFAs) [10], in order to perform multi-wavelength fiber laser.

Small equal-wavelength channel spacing, large number of peaks within broad band, and high output uniformity over channels are the concurrent requirements that compulsory to meet in performing multi-wavelength fiber laser [9]. The vital challenge is to mitigate the behaviour of homogenous gain broadening of erbium-doped fiber at room temperature to stabilize the multi-wavelength output. Many techniques had been demonstrated to suppress the homogenous gain broadening in erbium-doped fiber, including cooling EDF to cryogenic temperature [1], the four wave mixing effect [14, 15], the use of twin core (Erbium-Doped Fiber) EDF [16], and employment of PMF in a Sagnac loop ring cavity [17].

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