Brillouin Erbium Ytterbium Fiber Laser

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Abstract

This paper presents properties and characterizations of the Brillouin Erbium-Ytterbium Doped Fiber Laser (BEYDFL) system. BEYDFL systems have the potential to become multi-channel source in Dense Wavelength Division Multiplexing (DWDM) system. BEYDFL is a unique laser source that can produces multiple channels simultaneously with dense and constant channel spacing of about 0.084nm. This system utilizes the combination of two gain medium which are Brillouin gain and Erbium-Ytterbium gain to produce laser comb through cascading process. In the characterization stage of BEYDFL, laser comb consists of 22 channels with 1.34dB of channel's power variation operating in 1535nm region was obtained.

I. Introduction

Multiwavelength light sources have become a topic of extensive study recently due to their potential applications in dense wavelength division multiplexing (DWDM) transmission systems. In this system, the wavelength is independently modulated externally. Several techniques have been proposed to produce multiple wavelength sources [1]-[3].

A multiwavelength light source also can be obtained by using a hybrid BEYDFL by combining the nonlinear Brillouin gain from SMF and the linear gain in the EYDF [4]. The BEFL is able to generate a laser comb with a fixed spacing of approximately 11 GHz at room temperature. The BEYDFL of Figure 1 is only produce one Brillouin Stoke signal; however it can be used to generate multiple Brillouin Stoke through cascade techniques, either external cascade or internal cascade. Both techniques make use of same principle, which is the used of the generated Brillouin Stoke signal to act as the next Brillouin Pump successively to produce the subsequent Brillouin Stokes.

Externally cascades BEYDFL system is produced by taking the output of one BEYDFL and using it as the BP to a second BEYDFL. The process is sequentially continued until the Nth BEYDFL, which produce N Brillouin Stokes signals. An internal cascading technique uses a looping gain in the resonator, which reduces number of components and cost of the system.

In this paper, a multiwavelength BEYDFL (by incorporating internal cascading technique into single BEYDFL system) is proposed to generate multiple wavelengths which is important to enable DWDM operation with a low cost. Both BEYDFL and multiwavelength BEYDFL are pumped by a 1058nm laser diode using a forward pumping scheme. An optical isolator is inserted between EYDF and coupler to eliminate any backward propagating amplified spontaneous emission (ASE) and ensure unidirectional operation of the laser.

II. Experimental Setup

Figure 2 shows the configuration of the Multiwavelength BEYDFL system which was constructed using the similar components with the single wavelength BEYDFL of Figure 1. In particular, the SMF used in each BEYDFL was the same and hence the frequency shift between the Brillouin Stokes was almost identical.

The setup above is basically similar with the single wavelength BEYDFL system shown in Figure 1, except for the addition of two optical couplers A and B at both end of the SMF. The couplers used are 3dB coupler, which has a splitting ratio, r of 50% and one port of each coupler is connected each other. The EYDF which has an Er and Yb ion concentration of 1000 and 45, 000 ppm respectively and a cutoff

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