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Original research article

Dual-wavelength ring-cavity continuous-wave fiber laser based on semiconductor optical amplifier

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ABSTRACT

A dual-wavelength fiber ring-cavity laser based on InP/InGaAsP multi-quantum wells semiconductor optical amplifier is proposed and experimentally demonstrated. The proof of concept device consists of a semiconductor optical amplifier with InP/InGaAsP multi-quantum wells structure as the gain medium and two intracavity cascaded fiber Bragg gratings as wavelength selector by changing their operation temperature. The results demonstrate the new concept of dual-wavelength fiber laser based semiconductor optical amplifier with InP/InGaAsP multi-quantum wells structure and the technical feasibility.

1. Introduction

Dual-wavelength fiber lasers have drawn much attention due to their potential applications in optical fiber communication system, remote sensing instruments, fiber optic sensing, microwave/millimeter wave and THz photonics, as well as spectroscopy measurements [1–6], which can be divided into two kinds, one is all-fiber structure, and the other is non all-fiber structure. The all-fiber structure dual-wavelength fiber laser is one of the main research hot-point, To date, many different approaches to achieve stable dual-wavelength lasing have been demonstrated, such as cascaded fiber Bragg gratings (FBGs) in the laser cavity [7], symmetric and asymmetric linear fiber Bragg grating Fabry-Perot cavity [8–10], passively Q-switched fiber laser based on different saturable absorbers [11,12], phase-shifted gratings and sampled FBGs [13]. single fiber loop and dual-loop cavity [14], and external injection-seeding [15], etc. Recently, the semiconductor optical amplifier (SOA) has been of great interests due to its small size, light weight, low power consumption, and easy integration with other optical components. Pan et al. proposed a double-pulse laser based on SOA, double-pulses with pulse durations of 33.40 ns and 30.08 ns, with frequency repetitions of 10.05 MHz and 12.70 MHz are achieved [16]. Xu et al. proposed a novel narrow-linewidth dual-wavelength random fiber laser with single-mode operation based on SOA gain medium, a single-mode operation with narrow linewidth of similar to 1 kHz was achieved [17]. Hen et al. proposed a tunable dual-wavelength single-longitudinal-mode fiber laser based on a nonlinear semiconductor optical amplifier (NL-SOA) and an optical comb filter, a tunable dual-wavelength SLM oscillation with a wavelength spacing of 0.4 nm and a wavelength tuning range of about 56 nm has been achieved [18]. In our previous work, we reported the analytic function for the amplified spontaneous emission spectrum of InP/InGaAsP multi-quantum wells, the inhomogeneous broadening function is derived [19].

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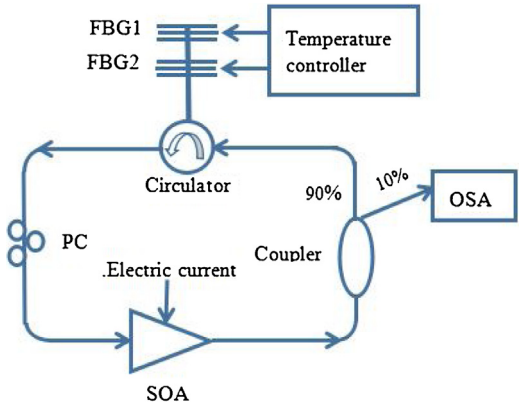

Fig. 1. Schematic diagram of dual-wavelength CW fiber laser based on SOA.

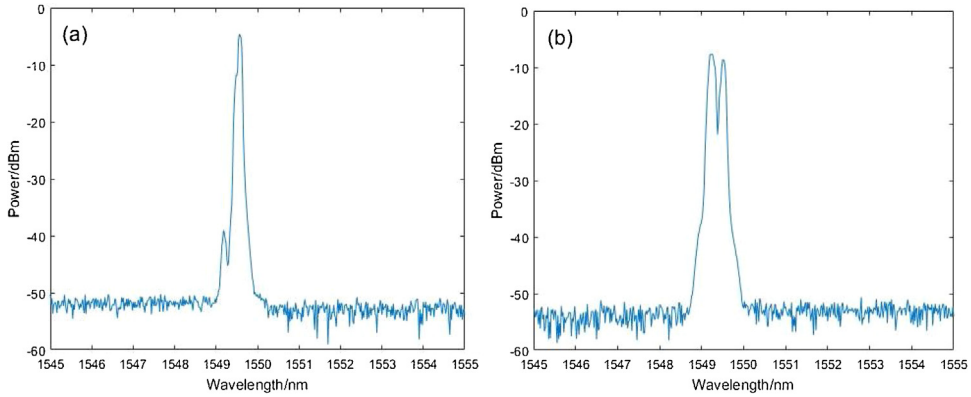

Fig. 2. Typical dual-wavelength lasing (a) before adjusting the PC; (b) after adjusting the PC.

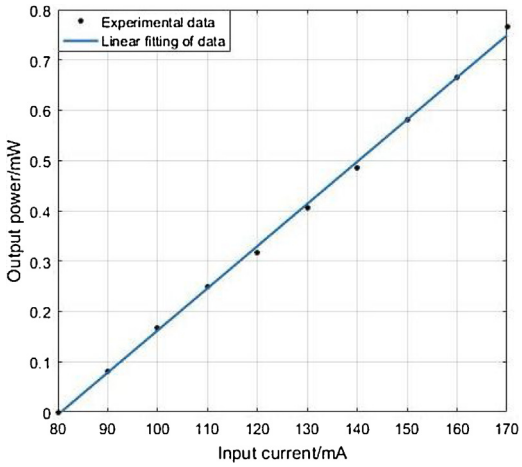

Fig. 3. Output power vs. input current at 1549.56 nm lasing.

In this paper, we propose and experimentally demonstrate a novel continuous-wave (CW) dual-wavelength fiber laser based on SOA with InP/InGaAsP multi-quantum wells structure, a couple of identical uniform FBGs are used as intracavity wavelength selectors. By controlling the operation temperature of the intracavity wavelength selectors, a CW dual-wavelength lasing is observed, and the wavelength spacing can be tunable by changing the operation temperatures of intracavity wavelength selectors.