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Abstract

In this paper, a tunable single-wavelength erbium-doped fiber ring laser is proposed. A novel fiber filter based on a large-core fiber is developed for suppressing the mode competition in erbium-doped fiber lasers (EDFLs). Under the pump power of 250 mW, single-wavelength lasing output is implemented with a side mode suppression ratio (SMSR) higher than 55 dB. By adjusting the curvature applied on the large-core fiber, stably tunable single-wavelength lasing output within the wavelength range from 1552.4 nm to 1563.2 nm is obtained with a 3 dB linewidth of 0.2 nm. Furthermore, the wavelength shift and peak power fluctuation are controlled within 0.02 nm and 0.5 dB by monitoring the lasing output with an interval of 6 min in one hour, respectively. A contrast experiments of a laser without tapering LCF are carried out to examine the importance of the taper in LCF-based filter. Experimental results demonstrate that the side modes of the lasing output can be effectively suppressed and thus SMSR can be improved from 41 dB to 58 dB by using a taper.

Keywords: large-core fiber; erbium-doped fiber laser; taper; curvature.

1 Introduction

In recent years, tunable single-wavelength erbium-doped fiber lasers (EDFLs) have been widely applied in optical communication systems, long-distance distributed optical fiber sensing systems, and optical signal processing [1-3] due to their distinguished characteristics, such as wide tuning range, high SMSR, narrow linewidth and high stability [4-6]. Because the laser's tunable range mainly depends on the tunability of filters [7], optical filters, such as, polarization-maintaining fiber (PMF)-based Sagnac filters [1, 3], Mach-Zehnder interferometers (MZIs) [2, 8], fiber Bragg gratings (FBGs) [9, 10] and various compounded fiber filters [6, 11, 12], have been used to obtain tunable single-wavelength EDFLs. Among them, the in-line MZIs (IMZIs), which have advantages of easy fabrication, small size, and compact in-line measurement, have attracted wide attention for the application of fiber laser and fiber sensor [13, 14].

There are several schemes to develop an IMZI [15-17]. In the early day, an IMZI is typically formed by tapering the single mode fiber (SMF). In 2006, Kieu K et al. firstly used a single-mode biconic fiber taper as an IMZI in EDFL, and realized a tunable single-wavelength lasing output over the wavelength range of 20.5 nm with a side mode suppression ratio (SMSR) of 45 dB [18]. In 2010, by using a two-taper IMZI, Bao X et al. proposed a C-band tunable single-wavelength fiber laser with the average SMSR increases to 47 dB and a tunable range of 15 nm [19].