Tunable Dual-Wavelength Double-Clad Er/Yb Fiber Laser With Self-Q-Switch and CW Operation

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Fiber lasers in the 1550 nm wavelength range have been extensively studied due to their characteristics of relatively "eye safe" operation and good free-space transmission with low insertion loss for applications in industrial manufacturing, range finding, free-space communications and light detection and ranging (LIDAR). Fiber lasers based on Erbium only exhibits efficient laser emission in single-mode laser systems restricting the fiber laser efficiency when single-clad fibers are used [1].

However with double-clad fibers (DCF) rising, has been feasible the development of reliable high power single-mode laser emission without a single-mode pump source. DCF cladding-pumping technique allows power scaling of rare-earth doped fiber lasers with a multi-mode pumping application [2]. Therefore, DCF-based lasers provide high efficiency, high beam quality and heat dissipation at high output power performance [3]. Erbium-Ytterbium double-clad fibers (EYDCF) provide an Erbium broad emission bandwidth with high gain over a 1550 nm wavelength range, making EYDCF lasers suitable for the design of high-power tunable sources. The Erbium ion pairs excitation causes a ground state depletion resulting in laser pulsations at relaxation frequency of population inversion with typical characteristics of passive Q-switched pulses called self-Q-switched (SQS) technique. Different SQS fiber lasers have been reported [4,5]. Nowadays, CW high-efficiency tunable dual-wavelength fiber lasers in the 1.55 Âţm region have been of growing interest due their potential application such as pump sources for 2 μm lasers.

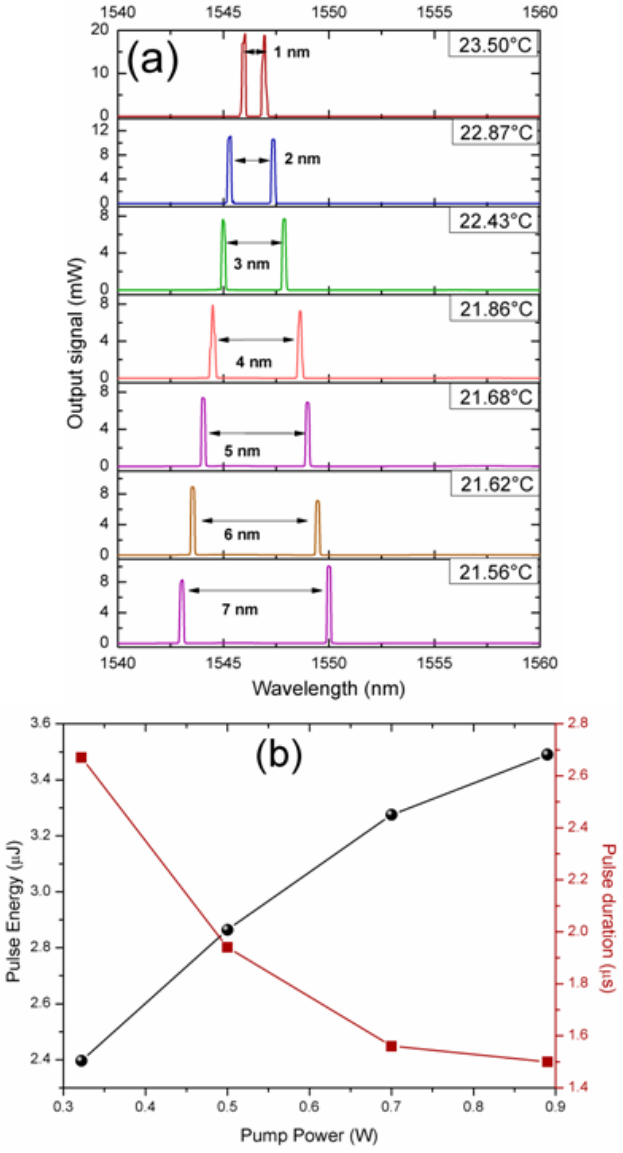

Figure 1: (a) Tunable dual-wavelength laser spectra with equal powers by Hi-Bi FOLM temperature; (b) SQS laser power energy and pulse duration versus pump power

We experimentally investigated an EYDCF dual-wavelength fiber laser with SQS and CW operations for different pumping power ranges. Dual-wavelength laser lines maximal separation of 7 nm is obtained (Figure 1(a)). SQS operation is observed with low pump power in a range from 322 to 890 mW. Minimum pulse duration of ∼1.5 μs and maximum pulse energy of ∼3.5 μJ are observed with the maximal SQS pump power (Figure 1(b)). With pump power up to 890 mW, CW operation is reached. A slope efficiency of 36.3% with a maximal output power of 3.6 W is obtained.

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