ALL-OPTICAL Q-SWITCHED FIBER LASER USING MODULATION OF OPTICAL LOSS

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Abstract: All-optical Q-switched fiber laser operating at 1549.4 nm upon 980 nm pumping was demonstrated with high controllability of pulse width and energy, which utilized optical loss modulation of the Er:Yb doped double-core W-shaped fiber.

1. INTRODUCTION

The Q-switching of fiber laser has potential to generate short and powerful pulses, which are useful in OTDR, fiber sensor systems, and medical surgical equipments and this has drawn tremendous attention for application of the fiber optics [1].

In this paper, we proposed and demonstrated an all-fiber-optical Q-switched fiber laser using inherent optical properties of the specially designed Er:Yb doped fiber without using any external modulator and it showed promising output enhancement of about 1460 times than non-Q-switched output.

2. EXPERIMENTS

The Er:Yb doped fiber for the Q-switching experiment was fabricated in-house using MCVD technique with concentrations of 375 ppm (molar) and 750 ppm (molar) for Er and Yb, respectively. The double-core W-shaped refractive index of the fiber with the core diameter of 7 μm and 3 μm, for inner core and outer core, respectively, and the corresponding numerical apertures were 0.21 and 0.07. The outer fiber diameter was 125 μm and the low-index polymer was used as the coating. An experimental arrangement of the Q-switched fiber laser is shown in Fig. 1 (FBG: 85% reflectivity at λ=1549.4 nm).

3. RESULTS

After applying 980 nm pump with 100 mW of power, the maximum output of the ring laser was 11.8 μW. When the optical loss modulation was introduced by the helical bending, the pulses with intense energy were obtained and recorded at the oscilloscope. The peak pulse power was 16.8 mW with the energy of 1.68 mJ at 100 ms pulse duration. The output pulse bandwidth was 0.1 nm centered at 1549.4 nm. The pulse duration was controlled by varying the helical bending extent of the fiber thereby changing the optical loss modulation. The typical outputs are shown in Fig. 2 for 50 µs pulses.

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