DBR Laser Based on Composite Fiber Heavily Doped with Erbium Ions

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Single-frequency fiber lasers are perspective sources of radiation for such areas as communications [1], high-resolution sensors [2], reflectometry [3], spectroscopy and other scientific applications [4]. Distributed feedback (DFB) fiber laser is the most popular among them due to the spectral filtering in a laser cavity formed by fiber Bragg grating (FBG) with a pi-phase shift inscribed in the core of active fiber [5,6]. The fabrication of a phase-shifted FBG is quite a challenging task in comparison with uniform FBG inscription, considering precise spatial position and amplitude of the phase shift to be created during the inscription process. Besides the DFB fiber laser, single-frequency generation with comparable output parameters is possible to achieve with a distributed Bragg reflector (DBR) laser scheme based on a short cavity with active fiber between two FBGs. However, development of DBR fiber laser with single-frequency generation based on Er^{3+} active fiber is a difficult task, owing to a low absorption cross-section of Er^{3+} active ions and a clustering problem in the case of high concentration of Er^{3+} ions. To avoid these disadvantages, a specially designed Er^{3+}-doped composite was developed [7]. The measured gain at the wavelength of 1535 nm was about 1.6 dB/cm and 3.1 dB/cm for fibers with the erbium oxide concentration of 1 wt% and 3 wt%, respectively. Using 1 wt% Er^{3+} active fiber in a DFB laser configuration with a cavity length of 5 cm, single-frequency lasing at 1559.5 nm with output power up to 3 mW at pump power of 320 mW was demonstrated [8].

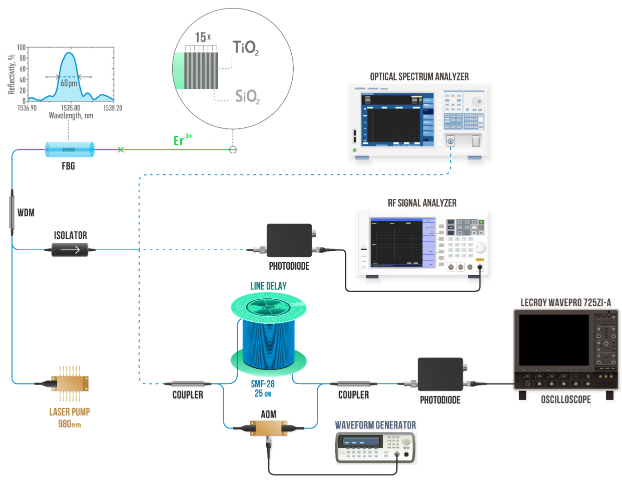

Figure 1: Experimental scheme

In this work, we present the results of DBR lasers development with an Er^{3+} active fiber of high concentration of active ions 3 wt% in a cavities with length less than 3 cm formed by two mirrors: FBG inscribed in the passive fiber and high reflective dielectric multilayer mirror deposited on the fiber end face. The DBR laser characteristics were measured in the scheme shown in Fig.1. In most of the studied cavity configurations, a single-frequency regime was achieved, and the characteristics corresponded to those for a DFB laser: the output power was more than 1 mW, the relative noise intensity was about -90 dB/Hz, and the instantaneous linewidth was $\sim$ 100 kHz.We will report on the details of the experiments, and discuss the potential applications of such laser sources.

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