Erbium Fiber Source of Ultrashort Pulses with Fundamental Repetition Rate of 300 MHz

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Fiber lasers with high repetition rates of ultrashort pulses have many applications. They are part of terahertz radiation sources [1], used to generate a supercontinuum [2], in high-resolution microscopy [3], and are planned for use in promising broadband communication systems [4]. Standard active fibers and fiber components do not allow for a fundamental repetition rate significantly higher than 100 MHz. An increase in the fundamental repetition rate is possible by reducing the length of the laser resonator. Short fibers with a high concentration of active ions and hybrid components are used for this purpose.

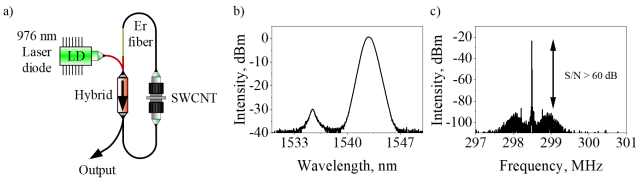

Figure 1: a) Scheme of an erbium fiber laser. SWCNT - connected ferrules, between which there are single-walled carbon nanotubes; A hybrid is a fiber element that combines the properties of a WDM, an insulator and coupler. The pumping direction is shown in red. b) Spectrum of signal; c) RF spectrum of signal

In the present work, we have investigated an erbium ring fiber laser operating in the passive mode locking regime. The experimental setup is shown in Fig. 1(a). As an active medium, we used a 12 cm long composite fiber with a phosphate glass core containing a high concentration of erbium ions and a silica glass cladding. The composite fiber was pumped by the laser diode at a wavelength of 976 nm through a hybrid (optical splitter (coupler), wavelength division multiplexer (WDM), insulator). The coupler split was 85/15 (15% tap out). Passive mode locking was provided by single-walled carbon nanotubes (SWCNTs [5]) synthesized in an aerosol and placed between two FC/APC optical connectors.

In this scheme, the total length of the resonator did not exceed 60 cm. The laser generated ultrashort pulses with a repetition rate of 298.5 MHz (RF spectrum of the signal Figure 1 (c)) and a duration of 1.6 ps at a center wavelength of 1543 nm. The spectral width was 1.3 nm (Figure 1 (b)). The output power was 1.64 mW.

Thus, we succeeded in realizing an erbium fiber laser with a high repetition rate of ultrashort pulses (300 MHz), which has good stability and generates a pulse train with a signal-to-noise ratio (S/N) $>$ 60 dB.

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