Spectral width and pulse duration tuning in Yb+ mode-locked fiber laser with birefringent Lyot filter.

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Abstract: A method of pulse duration and spectral width control in all-fiber Ytterbium mode-locked laser with SWCNT is presented. It is shown that PM-fiber can also serve as a spectrally selective filter.

Modelock lasers (ML) with saturable absorbers based on single wall carbon nanotubes (SCNT) currently are widely used. An important advantage of SA based on SWCNT in comparison with semiconducting SA is that its manufacture technology significantly simpler and can be implemented without using of expensive equipment. A number of research works have been studied the possibility of controlling the characteristics of mode-locked fiber laser with SA based on SWNTs [1,2]. This work is also devoted to this subject we investigated the possibility of spectral width and pulse duration tuning in Ytterbium mode-locked fiber laser based on SWCNTs.

Prospective solution of pulse duration management in Ytterbium mode-locked fiber lasers possible with using a birefringent fiber spectral filter [3] - analog of Lyot filter [4], which is used in solid state and liquid lasers to tune the emission wavelength over a wide spectral range. Fiber Lyot filter is described in [3] contains polarization maintaining fibers, which are spliced at an angle of 45^0. The length of the fiber segment used in fiber Lyot filter defines its parameters.

In this paper, we have developed this approach for the first time have shown the possibility of a fiber Lyot filter based on PM-fibers, when it is spliced to the fibers that do not support the polarization of the radiation. The experimental setup is shown in Fig. 1. Ytterbium laser resonator was created using a single-mode fiber, in which was added the segment of PM-fiber, acting as a fiber Lyot filter. Using the fiber segment with strong birefringence placed in a cavity consisting of a single-mode fiber without any additional polarizing element, the angle θ between the axis of the PM-fiber and the plane of polarization of the incoming radiation takes arbitrary values, however in this situation fiber Lyot filter will work, although the contrast of its transmission function will be undefined. In Fig. 2 shows the calculated transmission spectra of a fiber Lyot filter with three different values of the angle θ.

In Fig. 3 shows the emission spectra at different laser wavelengths PM-fibers (1, 1.5 and 2 m) and different settings of polarization controller. It is evident that a change in the length of PM-fibers allows you to adjust the width of the laser emission spectrum and polarization controller position at a fixed length of the PM-fiber and tune the wavelength of the laser radiation within certain limits. Using a fiber Lyot filter in combination with a polarization controller allowed to vary the width of the laser emission spectrum in the range of 0,15-1,25 nm. In Fig. 4 shows the autocorrelation traces of laser pulses with different lengths of PM-fiber. The pulse duration was varied in the range of 2 ps and 3.8 ps for the length variations of PM-fibers from 1 to 2 m.

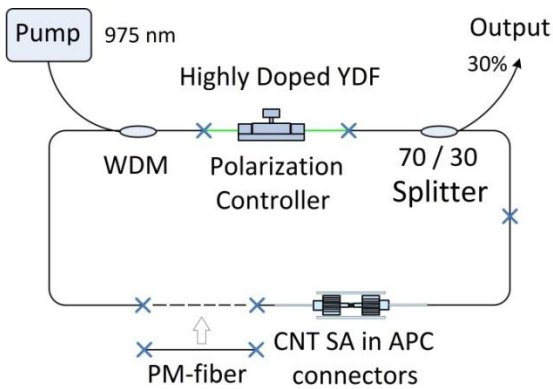

Fig.1 The scheme of Yb mode-locked laser with a SWNT-based SA.

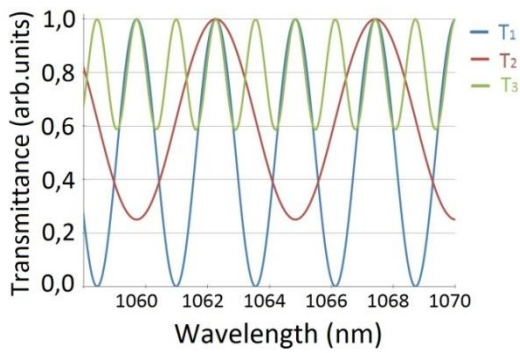

Fig.2 Calculation of fiber birefringent filter with different parameters

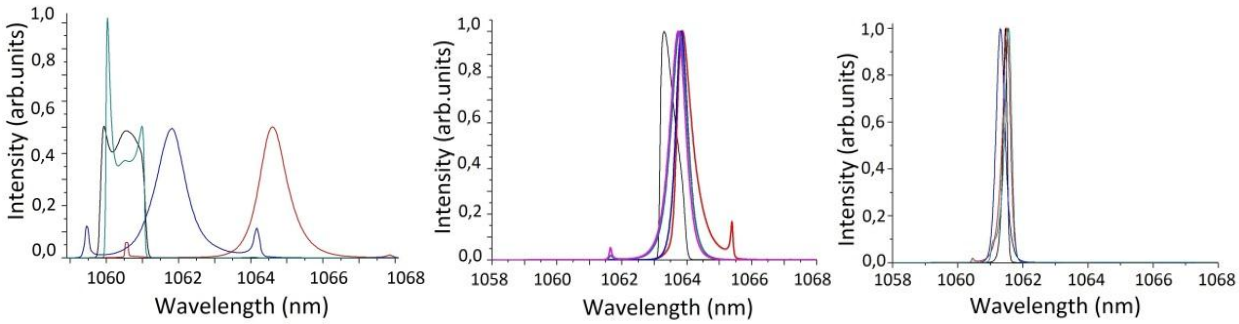

Fig.3 Emission spectra of Yb mode-locked fiber laser for different lengths of PM-fibers and different settings of polarization controller.

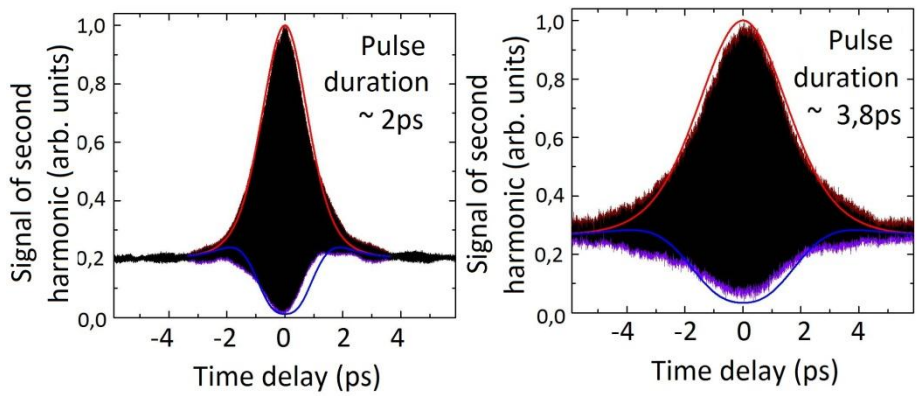

Fig.4 Autocorrelation traces of laser pulses at different lengths of PM-fiber

Thus, PM-fiber in resonator with fibers without polarization maintaining can also serve as a spectrally selective filter. In the presence of controller polarization in such kind of resonator contrast of the transmission function of the fiber birefringent filter and spectral positions of its peaks depend on the adjustment of polarization controller.

References:

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