Abstract of the doctoral dissertation of Zbigniew Łaszczych, M.Sc., entitled "Generation of ultrashort pulses in fiber lasers based on artificial saturable absorbers."

Femtosecond lasers are a direct link between the frequencies of electromagnetic waves in the infrared range and the frequencies on which modern electronics is based, i.e. microwave radiation. Stable sources of ultrashort pulses are the most stable "ruler" for measuring frequency and time, so such devices have found several applications in the areas of basic science as well as technological solutions. This dissertation was devoted to the generation of ultrashort laser pulses using artificial saturable absorbers. Systems using nonlinear optics phenomena, whose transient characteristics mimic saturable absorption, find their applications in fiber pulsed lasers. One of them is the nonlinear amplifying loop mirror (NALM), which is based on a nonlinear Sagnac interferometer. This dissertation presents experimental research work related to the use of the NALM in mode-locked fiber oscillators at the 1.56 and 1.98 spectral range.

The beginning of the dissertation presents issues related to the propagation of ultrashort laser pulses in optical fibers and their generation techniques. The types of saturable absorbers used in fiber lasers, and dispersive regimes of mode-locking are presented. Then the results of experimental work on NALM-based fiber oscillators were presented. An Er-doped fiber laser was presented, in which the output characteristics between two output ports were compared as a function of the net-cavity dispersion. A passive fiber shortening, an intra-cavity compressor and a dispersion compensating fiber was used for the net-cavity management. Of the results presented, the first method that allows the generation of pulses with the widest optical spectrum (over 90 nm) and a duration of less than 80 fs directly from the cavity oscillator. The second method, on the other hand, allows the net-cavity dispersion to be tuned over the widest range without significantly extending the cavity. The third method allows for potentially all-fiber dispersion compensation. In the normal dispersion regime, tunable operating states of the oscillator were observed, which depended on the width of the spectral filter used. The amplitude noise measured at both output ports of the oscillator was compared as a function of the net-cavity dispersion. The next section presents an all-fiber oscillator based on NALM. Using an active fiber with normal dispersion allowed partial compensation of the net-cavity dispersion, but the oscillator operated in the regime of conventional solitons. The last chapter was devoted to the NALM-based Tm-doped oscillator, in which both single-pulse and dynamic performance characteristics were investigated from selfstarting multi-pulse to single-pulse operation.

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