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Arbitrary Waveform Generation by Cavity Dumping of Hybrid Fibre Laser with Two Active Media

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We present a new practical method for direct laser synthesis of arbitrary optical waveforms with nanosecond resolution. It is based on partial dumping of cavity in the hybrid fiber laser with two amplifying media, namely, erbium-doped fiber amplifier (EDFA) and semiconductor optical amplifier (SOA). Use of EDFA in combination with SOA prevents cavity dumped operation from relaxation oscillations. Such oscillations inherent in case of pure EDFA-based lasers and restrict possible timing for cavity dumping [1]. In the proposed configuration (Fig. 1(a)), EDFA operation is assisted by preamplification in the deeply saturated SOA which features relatively fast (sub-nanosecond) gain recovery. This approach allows sustaining nearly constant radiation power at the EDFA input when the laser cavity undergoes partial dumping, and thus prevents relaxation oscillations. As compared with pure SOA-based cavity-dumped configurations [2], the combined active media gives tenfold increase in output laser power and energy. It allows synthesis of arbitrary optical waveforms with energy up to 50 nJ within the nanosecond time scale. Power characteristics of the laser system are shown in Fig. 1(b). Figure 1(c) presents time trace of the synthesized optical waveform. For comparison, Fig. 1(d) illustrates an attempt to synthesize the same waveform without use of SOA in the laser. It appeared to be greatly affected by relaxation oscillations.

Thus, the proposed method allows accurate laser synthesis of nanosecond-scale optical waveforms with freely-tunable repetition rate and relatively high energy by digitally controlled partial dumping of the fiber laser cavity.

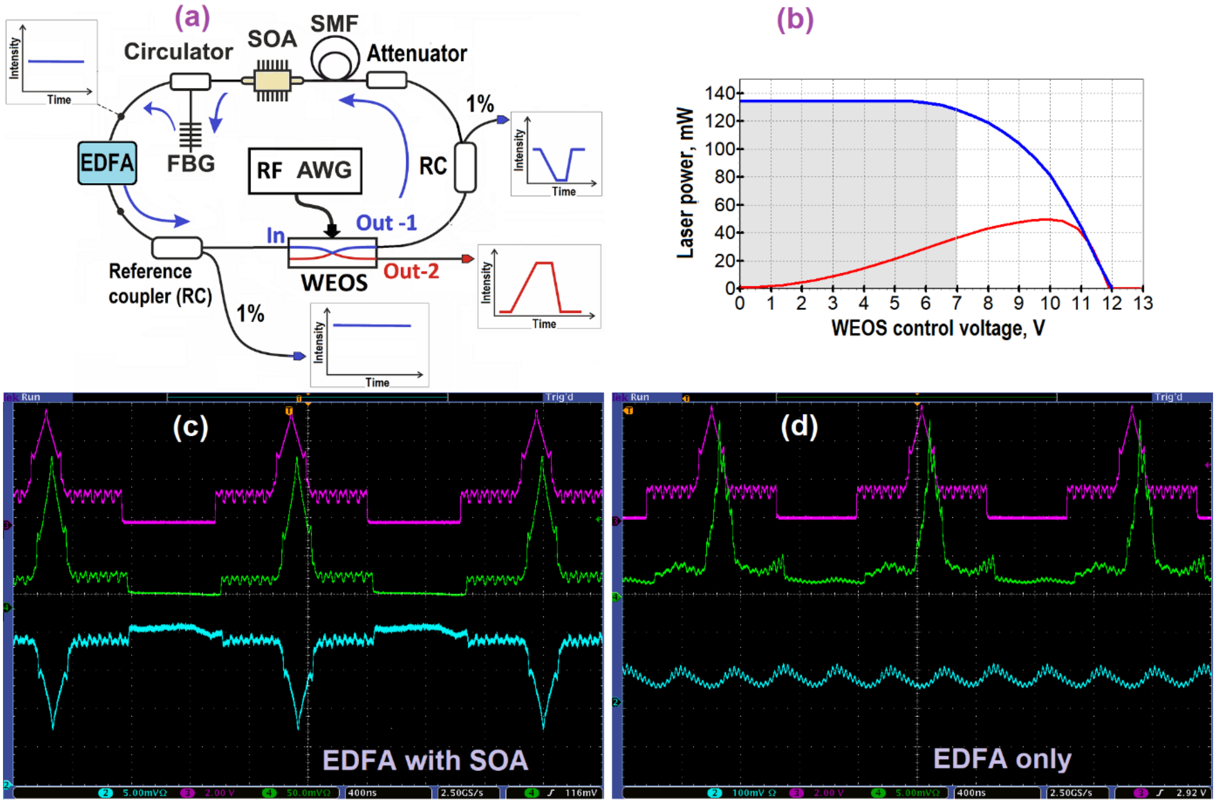

Fig. 1 (a) – schematic of the laser: WEOS – waveguide electro-optic switch, RF AWG – radiofrequency arbitrary waveform generator; (b) – laser radiation power versus control voltage: blue curve – power at the WEOS intracavity input port, red curve - power at the WEOS extracavity output port; (c, d) - time traces of control electric signal (upper trace), optical waveform dumped via the WEOS, and residual intracavity laser power variation (lower trace).

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