

All-fiber supercontinuum generator with high-energy pulses

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Super-continuum generation in non-linear optical fibres pumped with ultra-short light pulses (within femtosecond to nanosecond range) is usually accompanied by decay of the pumping pulse into several (or a plurality) of super-continuum pulses with different energies [1-3]. In time domain this corresponds to a super-continuum pulse train where intervals between pulses are of the same order as the pulse duration or longer. When pumped with nanosecond pulses the super-continuum pulses retain their integrity at nanosecond scale, that's why in this case super-continuum pulses can be characterised by such parameters as pulse energy, duration, etc.

Recent progress in development of high-energy nanosecond mode-locked fibre master oscillators with ultra-long resonators [4] enables creation, on the basis of such lasers, of all-fibre super-continuum generators with relatively high pulse energies. In the present paper for the first time the results of investigations into such super-continuum generator with 40- μ J pulse energy are reported.

All-fibre all-positive-dispersion mode-locked ring Yb fibre laser was used as the master oscillator with optical resonator length of 8 km (Fig. 1). At maximum average output power 150 mW at wavelength of 1100 nm and repetition rate 37 kHz the energy of 10-ns pulses was 4 μ J. Radiation from this laser was amplified in a fibre amplifier up to average radiation power \sim 2 W and then was directed into a 30-m long micro-structured fibre SC-5.0-1040 (Crystal Fiber). At the output from the fibre we obtained super-continuum radiation within 500–1750 nm (long-wavelength boundary was limited by spectrum analyzer) at 1.5 W of average power and pulse energy 40 μ J. As far as we know, this is the highest super-continuum energy pulses reached to date. The super-continuum generation spectrum is given in Fig. 2.

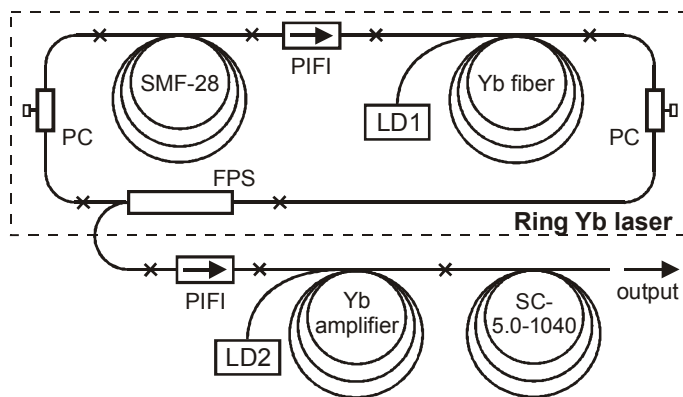


Fig. 1. All-fiber supercontinuum generator setup: PC – polarization controller, PIFI – polarization-independent fiber isolator, FPS – fiber polarization splitter, LD1,2 – pump laser diodes

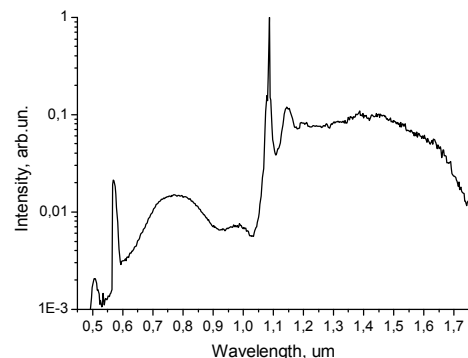


Fig. 2. Optical spectrum of generated super-continuum with 40 μ J pulses

The present report details results of experimental investigation of the created super-continuum generator and the results of modelling its modes of operation.

References

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