

*Modeling, Optimization and Design of
Fiber-based Passive and Active Devices*

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Examples

» Fiber Amplifiers and Lasers

- » Two-stage EDFA with Midstage GEF
 - » **Q-switched Yb-doped Fiber Ring Laser**
 - » Multipump Raman Amplification
-

mJ Q-switched Cladding-pumped Yb-doped Fiber Ring Laser

Description

In the field of rare-earth-doped silica fiber applications, there has been a growing interest in high-power cladding-pumped fiber lasers using Er and Yb ions as active dopants. Such lasers can be operated in the pulsed mode by using the Q-switching technique and are capable of generating pulses with multi-millijoule energies, peak powers of the order of 10 kW and durations of the order of 100 ns. These characteristics, as well as high spatial beam quality and compact uncooled laser arrangement make fiber lasers an attractive source for typical high-power pulsed applications such as, for instance, range finding, nonlinear frequency conversion or material processing that until recently have been dominated by conventional solid-state lasers.

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Typical Results

The simulation setup for a high-power Q-switched Yb-doped fiber (YDF) ring laser [1] is shown in [Figure 1](#). The cladding-pumped doped fiber is simulated by a lumped dynamic model. The Q-switching is achieved by an acousto-optical Switch (AOS). The pulse train at the laser output is shown in [Figure 2](#). Many round trips (with as many simulation iterations) are required for the slow build-up of the population inversion, while a few iterations are sufficient for a fast build-up of the laser radiation from the noise level. The peak power, pulse energy, duration and shape depend on the laser parameters, AOS switching times, pulse repetition rate and cavity length. For example, the pulse shape can demonstrate both multipeak and single-peak features, as shown in [Figure 3](#). In case of a lower repetition rate (50 kHz), the accumulated inversion level is higher because of a longer time between successive AOS switching. This leads to a faster build-up of radiation within the cavity round-trip time. The round trips of radiation in the ring cavity deplete the accumulated inversion to form clearly separated peaks in the laser output.

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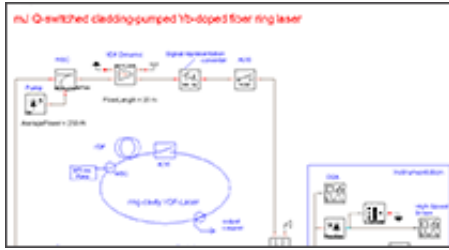
Further Information

Keywords: Cladding-pumped, Erbium, Fiber Laser, High-power, Q-switched, Ytterbium

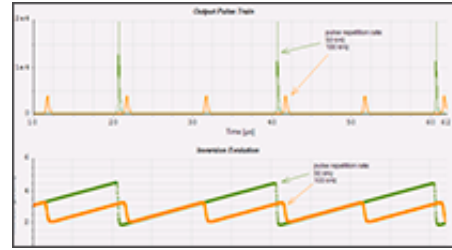
Similar demonstrations are available in [VPIcomponentMaker Fiber Optics](#), [VPItransmissionMaker Optical Systems](#) and on the [VPIphotonics Forum](#).

[1] I. Koltchanov, O. Minchenkova, A. Richter, OFC/NFOC 2006, paper JThB82, 2006

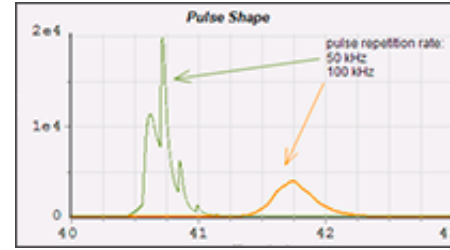
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» Figure 1



» Figure 2



» Figure 3

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