

# Passively Q-switched Er-Yb double clad fiber laser with $\text{Cr}^{2+}:\text{ZnSe}$ and $\text{Co}^{2+}:\text{MgAl}_2\text{O}_4$ as a saturable absorber

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Passive Q-switching of fiber lasers with saturable absorbers have attracted attention because of simplicity and high efficiency. However, the number of known materials which can be used as a saturable absorber is relatively limited due to the features of fiber lasers. While liquefying gallium mirror, semiconductor structures (SESAM), as well as  $\text{Co}^{2+}:\text{ZnSe}$  and  $\text{Co}^{2+}:\text{ZnS}$  crystals are recent examples of saturable absorbers that have been used in Q-switched fiber lasers, any new material which can be used for this is still very interesting.

Here we report, for the first time to our knowledge, a cladding-pumped passively Q-switched Er-Yb codoped fiber laser with  $\text{Cr}^{2+}:\text{ZnSe}$  and  $\text{Co}^{2+}:\text{MgAl}_2\text{O}_4$  as saturable absorbers.

The fiber laser configuration consists of a 5 m circular double-clad Er-Yb codoped fiber and an external cavity. Pump light at 915nm was coupled into the fiber through a perpendicularly cleaved fiber end facet. This also serves as a 4% reflecting, outcoupling, cavity mirror. In the other end of the cavity a lens system and a high-reflection (1550 nm) mirror provided external feedback. The lens system had an intermediate focus, where the saturable absorber was located. The intermediate focus waist diameter was typically 20  $\mu\text{m}$ . We used the same laser configuration for both the  $\text{Cr}^{2+}:\text{ZnSe}$  and the  $\text{Co}^{2+}:\text{MgAl}_2\text{O}_4$  crystals.

The maximum average output power for both crystals was 1.4 W, for 6.5 W of absorbed pump power. The maximum obtained pulse energy was 18  $\mu\text{J}$  (45W peak power) with  $\text{Cr}^{2+}:\text{ZnSe}$  saturable absorber. Typical pulse duration was 370 – 700 ns. The repetition rate was varied between 20 and 85 kHz.

The maximum pulse energy was 22  $\mu\text{J}$  (60W peak power) with  $\text{Co}^{2+}:\text{MgAl}_2\text{O}_4$  saturable absorber. The pulse duration was 370 – 600 ns. The repetition rate was varied between 15 and 65kHz.

Further details and comparisons of fiber lasers passively Q-switched with  $\text{Cr}^{2+}:\text{ZnSe}$  and  $\text{Co}^{2+}:\text{MgAl}_2\text{O}_4$  crystals will be presented.