

## **Zinc-oxide nanoparticle-based saturable absorber deposited by simple evaporation technique for Q-switched fiber laser**

### **ABSTRACT**

A Q-switched erbium-doped fiber laser (EDFL) incorporating zinc-oxide (ZnO) nanoparticles-based saturable absorber (SA) is proposed and demonstrated. To form the SA, the ZnO nanoparticles, which are originally in the powder form, are first dissolved in ethanol and subsequently deposited onto the surface of fiber ferrule by using the adhesion effect with the evaporation technique. By integrating the ZnO nanoparticle-based SA into a laser cavity of an EDFL, a self-started and stable Q-switching is achieved at a low threshold power of 20.24 mW. As the pump power is increased, the pulse repetition rate is tunable from 10.34 kHz to 25.59 kHz while pulse duration decreases from 21.39  $\mu$ s to 3.65  $\mu$ s. Additionally, this Q-switched laser has a maximum energy per pulse of 19.34 nJ and an average output power of 0.46 mW. These results indicate the feasibility and functionality of the ZnO nanoparticles-based SA for Q-switched generation, which offers the flexibility and easy integration of the SA into a ring laser cavity.

**Keyword:** Zinc oxide; Saturable absorber; Q-switched; Fiber laser