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Title :
Q-Switching and Mode-Locking Pulse Generation Based on Passive Techniques

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The field of fiber lasers and fiber optic devices has experienced a sustained rapid growth despite witnessing the infamous 'telecom bubble burst'. All-fiber optic devices have inherent advantages of relatively low cost, compact design, light weight, low maintenance, and increased vibration tolerances. In this research, various new fiber lasers operating in Q-switching and mode-locking modes are proposed and demonstrated. At first, Q-switched Erbium-doped fiber lasers are demonstrated using a homemade passive saturable absorber (SA) based on single-walled carbon nanotubes (SWCNTs) and graphene oxide films. For instance, with the use of a SWCNTs-Polyvinyl alcohol (PVA) SA, the laser has a multi-wavelength output at 1533.5 nm region with a repetition rate of 13.1 kHz, pulse width of 7.2 μs and pulse energy of 21 nJ at the pump power of 64 mW. Two mode-locked EDFLs are also demonstrated using a homemade SA based on SWCNTs. For instance, a stable mode-locked EDFL is demonstrated using SWCNTs-PVA SA to generate a dissipative soliton pulse train operating in 1533.6 nm region. At pump power above the threshold value of 35.2 mW, the EDFL generates a self-starting pulse train with duration of 1.8 ps and repetition rate of 15.3 MHz. Besides showing good Q-switching and mode-locking performances, the proposed new saturable absorbers are easy to fabricate and cheap. Finally, we explore a new technique based on nonlinear polarization rotation (NPR) to demonstrate both Q-switched and mode-locked fiber lasers.For instance, a stable passive Q-switched EDFL operating at 1534.5 nm region is demonstrated by employing a polarization dependent isolator and a highly nonlinear Erbium-doped fiber (EDF) to induce intensity dependent loss in a sufficiently-high lossy ring cavity. A simple NPR based EDFL with three switchable operation states have also been successfully demonstrated by employing a 6.9 km long dispersion shifted fiber (DSF) in the ring cavity. It firstly generates a square dissipative soliton pulse with a repetition rate of 87 kHz.Then, the laser produces a fundamental repetition rate of 29 kHz with a fixed pulse width of 8.5 μs with the maximum pulse energy of 131.5 nJ is achieved at the pump power of 116.7 mW. Finally, the EDFL produces a fixed pulse width of 2.8 μs and harmonic pulse repetition rate of 58 kHz. Q-switched and mode-locked EDFLs have wide and important applications in many fields such as optical communications, laser micro-machining, optical sensors and laser ablation.