Single and Bunch Soliton Generation in Optical Fiber Lasers Using Bismuth Selenide Topological Insulator Saturable Absorber

ABSTRACT

In this work, we present the generation of two distinct types of soliton pulses using a Bismuth Selenide (Bi_2Se_3) saturable absorber (SA) synthesized in our laboratory. The soliton pulses were generated in two different laser cavity configurations, resulting in two types of solitons: a soliton pulse with Kelly sidebands and a bunched soliton pulse with peak-dip sidebands. Both solitons operated at the fundamental repetition rate—23.3 MHz (for the soliton with Kelly sidebands) and 13 MHz (for the bunched soliton with peak-dip sidebands). We observed that the accumulation of nonlinear phase shift from the added single mode fiber (SMF) split the single soliton pulse into 44 pulses in a bunched oscillation envelope. At the same time, peak-dip sidebands were imposed on the bunched soliton spectrum due to constructive and destructive interferences between soliton pulse and dispersive waves. The measured pulse width for both solitons were 0.63 ps (for the soliton with Kelly sidebands) and 1.52 ps (for the bunched soliton with peak-dip sidebands), respectively. Our results demonstrate the potential of Bi_2Se_3 SAs in generating different types of soliton pulses, which could have potential applications in various areas of optical communication and spectroscopy.