Investigation of tungsten trioxide as a saturable absorber for mode-locked generation

ABSTRACT

Low-dimensional materials as saturable absorbers (SA) for pulsed laser applications have gain wide interest due to high nonlinearity and strong light-matter interaction. Various materials have been investigated such as graphene, transition metal oxides (TMO), transition metal dichalcogenides, and topological insulators. Tungsten trioxide (WO3); a cheap and nontoxic type of TMO has not yet been investigated for mode-locked pulsed fiber laser (MLFL) generation despite extensive employment as applications in other fields. WO3 is very attractive with spectral absorption extending in the broad near infra-red region, good mechanical strength, high resistance to photo corrosion, and is one of the few oxides that has high thermal and chemical stability. A tungsten trioxide (WO3) based saturable absorber (SA) fabricated via deposition of WO3 composite on tapered fiber was demonstrated. The WO3 weight percentage was varied from 0.005 to 1.235 wt% to investigate the effect on nonlinear saturable parameters and on mode-locked lasing performance. It was determined that the nonlinear saturable parameters were not dependent on weight percentage within its working range; 0.025 to 1.103 wt%. The generation self-started with 35–70 mW pump power, where the pulse durations and spectral bandwidths fall within the range of 810–940 fs and 8–12 nm, respectively. This experimental investigation provides insight on WO3 as a saturable absorber for mode-locked pulse laser generation. The utilization of this nanomaterial is aimed to cut down the cost the existing SA technology while providing enhanced durability and shelf-life.

Keyword: Mode-locking; Tungsten oxide; Saturable absorber; Tapered fiber