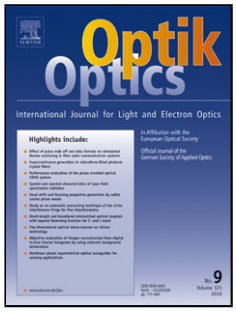

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Nd:YAG laser at 1112.3 nm passively Q-switched by graphene-oxide saturable absorber

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Abstract: A passively Q-switched Nd:YAG laser at 1112.3 nm with graphene-oxide (GO) as a saturable absorber (SA) is presented. GO-SA is directly deposited in a long-wave-pass filter by vertical evaporation method. This filter effectively reduces the influence of pump light on the GO saturable absorption. The pulsed laser is realized at the threshold of 3.69 W. The repetition rate is tunable from 92 kHz to 220 kHz, and the maximum output power and the narrowest pulse width are 620 mW and 145 ns, respectively.

Key words: Nd:YAG laser; 1112.3 nm; graphene-oxide.

1 Introduction

LD-pumped pulse lasers with short-pulse width and high-energy pulse have attracted attention for applications in rang finding, optical communication, medicine and material processing [1-2]. Nano-materials hold wide potential applications for new SAs due to their remarkable optoelectronic and optical properties [3-5]. In recent years, graphene, GO, topological-insulators, and transition-metal-dichalcogenides have been shown to possess a high nonlinear susceptibility, which have led to the demonstration of numerous nonlinear optical phenomena, such as saturable absorption.

The 1112 nm laser is generated through the R_2 ($^4F_{3/2}$) → Y_6 ($^4I_{11/2}$) with very low emission cross-section of 3.6 × 10^{-20} cm^{-2}, while the line at 1064 nm is realized through the R_2 ($^4F_{3/2}$) → Y_3 ($^4I_{11/2}$) with very high emission cross-section of 45.8 × 10^{-20} cm^{-2}. The line at 1112 nm has the same high level with that at 1064 nm, and the emission cross-section at 1064 nm is larger 10 times than that at 1112 nm. So the line at 1112 nm is very difficult to oscillate due to strong spectral competition [4-5]. In order to solve the problem, the cavity must be subtly to designed to suppress spectral competition. In this paper GO SA is fabricated by the vertical evaporation method and a pulsed Nd:YAG laser at 1112.3 nm is reported. The minimum pulse width is only 145 ns.

2 Experimental Setup

The cavity is a 24 mm long, standard two-mirror plane-plane cavity as shown in Fig.1(a). The laser gain medium is finely polished Nd:YAG crystal with the dimensions of Φ 3 mm × 5 mm. The front side (M_{in}) of the crystal with high-reflectivity coating at 1112 nm and anti-reflection coating at 808 - 950 nm is used as the input mirror. M_{oc} is the output coupler with part transmission of 4.4% at 1112 nm and high transmission of 96.2% at 1064 nm as shown in Fig. 2. In this chosen cavity, the line at 1112 nm have a large gain, while the line at 1064 nm has a very high loss. The pump threshold ratio of the lines at 1064 nm and 1112 nm is about 4.9. The line at 1112 nm has a lower threshold, and it is easier to emit.

The GO sheet is deposited onto a long-wave-pass filter with high-reflectivity coating at 808 nm and anti-reflection coating at 1064 nm through a vertical evaporation method. The low-power transmissivity of the GO filter is about 81% at 1064 nm. The filter can effectively reduce the influence of pump light on the GO saturable absorption.