摻釹釩酸釓與摻釹釩酸鑥之被動鎖模雷射

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摘　　　要

在此篇論文，我們比較四種不同的摻釹釩酸釓(Nd:$GdVO_4$)與摻釹釩酸鑥(Nd:$LuVO_4$)之被動鎖模雷射，分別使用半導體飽和吸收鏡，非線性鏡，雙鎖模技術以及摻鉻釔鋁石榴石(Cr:YAG)之飽和吸收體。利用半導體吸收鏡及非線性鏡我們可以產生低閥值之鎖模摻釹釩酸釓雷射。實驗上量測的連續鎖模閥值和理論計算的連續及 Q 開關鎖模之邊界的腔內功率是相當吻合。此外，我們推導出的連續鎖模切換至諧頻鎖模之臨界激發功率亦合乎量測結果。為了追求更高的輸出功率，我們考慮使用雙鎖模技術產生 Q 開關鎖模並且得到 200 皮秒的鎖模脈衝，140 赫茲的低重複頻率和 1.73 千瓦的高峰值功率之穩定輸出。另外，我們將飽和吸收體摻鉻釔鋁石榴石至入摻釹釩酸鑥雷射中。我們得到相當低重複頻率 6 千赫茲率，更窄的脈衝寬度 100 皮秒。最重要的是我們大大降低了 Q-開關波包內的脈衝數目至六根脈衝。 因此我們產生出最高的 200 千瓦的巨大的峰值功率及 0.1 毫焦耳的高能量

Passively Mode-Locked Nd:$GdVO_4$ and Nd:$LuVO_4$ Lasers

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ABSTRACT

In this thesis, we characterize and compare the performance of passively mode-locked Nd:$GdVO_4$ and Nd:$LuVO_4$ lasers by using semiconductor saturable absorber mirror, nonlinear mirror, the dual mode-locked technique and Cr:YAG absorber. We demonstrated low threshold mode-locked Nd:$GdVO_4$ lasers by using semiconductor saturable absorber mirror and nonlinear mirror. The measured thresholds of continous wave mode locking (CW-ML) is accordant with theoretically calculated values considering the critical intracavity power for stability of CW-ML against the Q-switching mode-locking (QML). Besides, we derived that critical pumping power from CW-ML to harmonic mode locking agrees well with measurement. In order to pursue the higher power, we have also considered the QML state by the dual mode-locked technique and we obtained regular QML with mode-locking pulse of 200 ps, low repetition rate of 140 kHz, and high peak power of 1.73 kW. Furthermore, we used a Nd:$LuVO_4$ laser crystal with a Cr:YAG absorber and we have achieved a really slow repetition rate of 6 kHz and much narrower pulse of 100 ps under a Q-switch pulse. Most importance of all is that we greatly reduce the pulse numbers under the envelope to only six pulses. Thus, huge peak power of 200 kW, the largest ever with high pulse energy of 0.1 mJ has also been demonstrated.

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