藉由雙光子誘發光電流回饋控制之映射色散

似噪音及鎖模摻鐿光纖雷射

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摘要

似噪音脈衝自第一次被發現於摻鉺光纖雷射直至今日，已引起眾多研究者的興趣，並且在光學同調斷層掃描系統(optical coherence tomography)以及雷射誘導擊穿光譜(laser-induced breakdown spectroscopy)皆擁有良好的表現。因此，若我們能建構一套開機即自動輸出似噪音脈衝之光纖雷射，不論是在學術研究或是產業應用上都能帶來更多的便利性。在本篇論文中，我們報導以適當之回饋控制使一台映射色散摻鐿光纖雷射自動產生似噪音脈衝或鎖模脈衝。似噪音脈衝通常擁有寬且平滑的光譜，我們將光譜寬度作為回饋控制之反饋信號，可以選擇性地產生似噪音脈衝或是鎖模脈衝。我們在理論模擬及實驗中皆證實利用似噪音脈衝作為光二極體之激發光源可產生較高的雙光子吸收(two-photon absorption，簡稱 TPA)誘發光電流信號。這也可以作為回饋控制之反饋信號，成功讓雷射在開機後數分鐘內自動達到穩定的似噪音脈衝輸出。

Auto-setting of noise-like and mode-locked dispersion-mapped Yb-doped fiber laser using two-photon-induced photocurrent as the feedback signal

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Abstract

Since the first demonstration of noise-like-pulse (NLP) operation in the ring cavity of an Er-doped fiber oscillator, there has been tremendous interests in this special regime of mode-locked fiber lasers. NLPs have been proven to be successfully applied to both optical coherence tomography (OCT) and laser-induced breakdown spectroscopy (LIBS). Therefore, it is desirable to build up a mode-locked fiber laser system which can automatically generate NLPs. In this thesis, I construct a dispersion-mapped ytterbium-doped fiber laser system which can automatically produce NLPs output by a proper feedback control method. Firstly, we choose the 3-dB optical bandwidth as the feedback signal since NLPs have broad and smooth optical spectrum compared to conventional mode-locked pulses (MLPs). Then, the fiber laser system can selectively generate NLP and MLP output. Secondly, it is shown that two-photon absorption (TPA) from a GaAsP photodiode can best discriminate the NLP from the MLP. By using two-photon-induced photocurrent as the feedback signal, automatic mode-locking of a dispersion-mapped Yb-doped fiber laser system is successfully demonstrated. This system can autoset to a stable NLP or MLP state within a few minutes.