LD 泵浦红光激光器

电子科学与技术学院光信息科学与技术专业　温龙燕

（学号：2004111155）

指导教师：杜晨林

摘要：激光二极管泵浦的全固态激光器（Diode-pumped solid-state laser，DPSSL）具有总体效率高、寿命长、光束质量好、结构简单、体积小、重量轻等优点，在军事、医学、信息、工业、科研等领域得到了广泛的应用，尤其是高功率红、绿、蓝激光器，成为大屏幕、高清晰度激光彩色显示的研究热点。本论文围绕全固态红光激光器进行了大量的理论分析和实验研究，其主要研究内容概括如下:

1，概述了全固态激光器的发展历史和研究现状;介绍了全固态激光器目前常用的激光材料:总结了国内外固态红激光器的应用和研究现状。

2，从增益介质中饱和光强的微分方程出发，讨论了 LD 端面泵浦固体激光器的输入输出特性、阈值泵浦功率等;从耦合波动方程出发，对 LD 端面泵浦激光器腔内倍频进行了理论分析;考虑激光晶体的热透镜效应，对热稳腔的设计作了详细地理论分析和数值模拟。

3，对 Nd:YVO_4 晶体进行了介绍，包括其激光特性等。

4，介绍了 LBO 晶体的物理与非线性特性，分析了其临界相位匹配特性。

5，对调 Q 技术进行了介绍与理论分析。

6，进行了 LD 端面泵浦 Nd:YVO_4 晶体，发出 1342nm 的激光，然后通过腔内 LBO 晶体对 1342 nm 的激光倍频获得 671 nm 连续红光最大输出功率 192mW；在腔内加上调 Q 技术后，可获得脉冲红光，提高了倍频光的峰值功率。当 Q 开关重复率为 30kHz,泵浦功率为 20W 时，输出的红光激光的最高功率达 980mW，脉冲宽度为 138ns。

7，给出红光激光的实验装置并通过实验过程中所遇到的问题进行分析。如实验装置图的改进、Nd:YVO_4 晶体放置的位置对于成功产生红光基模光斑的重要性、腔内倍频如何提高倍频效率。

关键词：激光二极管；端面泵浦；固体激光器；Nd:YO_4；LBO

Abstract: Diode-pumped solid-state lasers（DPSSL）have been attracting great intreat due to their many good advantages,for example,high efficiency,long lifetime, excellent beam quality,simple structure,high reliability and compact size. They are used widely in military,medical treatment, information, industry, scientific researches and many other fields, especially research on the LD end-pumped all-solid red laser. The main contents are as follows:

1. The development and the characteristics of DPSSL are summarized. Various laser materials are introduced. Especially, the developments of all-solid-state Red laser are introduced in detail.

2. Based on the differential equation of saturated intensity in gain media, the output characteristics of DPSSL are theoretically analytical of the output power, threshold pump

power and slope efficiency are derived respectively of lasers crystals, using our experimental conditions ,are numerically simulated.

3. The structure and general properties of Nd:YVO_4 cyrstal are researched and discussed , and its important parameters are listed at the meantime.
4. The physical and nonlineas characters of LBO crystal are introduced; its critically-phase-matched characters are analyzed.
5. Introduce the teconology of Q-switched ,it is reseasched and discussed.
6. A maximum continuous-wave output power of 192mW at 671nm has been obtained by intracavity frequency doubling with LBO crystal in an Nd:YVO_4 laser; and then through the Q-switched, the maximum output power is 980mW when the frequency of the Q-switched is 30 kHz.
7. The experimental device of the red laser was described. Some problems which we encountered in experiment, such as improvement of experimental setup, the importance of Nd:YVO_4 crystal's position for obtaining red laser successfully, and how to increase the efficiency of frequency-doubling, were discussed.

Key Words: laser diode; end-pump; all-solid-state laser; Red; Nd:YVO_4; LBO

教师点评：本论文是利用 LD 泵浦 Nd:YVO_4晶体产生 1342nm 的激光，采用腔内倍频 LBO 晶体技术获得了最高 192mW 功率的连续红光激光输出；再在 Nd:YVO_4晶体后面加上调 Q 技术后输出脉冲红光，最高功率为 980mW。