

# 半导体激光器与光纤的耦合技术研究

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**摘要:** 半导体激光器和光纤组成的整体在光纤通信网络、激光医疗、材料加工等领域有着广泛的应用。本论文围绕海特公司生产的 980nm 半导体泵浦激光器, 讨论了不同的耦合方法, 并为本项目所使用激光器量身定做了一套实验方案, 旨在提高激光入纤效率。理论分析了提高 LD 与光纤耦合效率的思路, 并制定了相应的方案。利用 BeamPROP 软件对柱透镜、球透镜、GIF 光纤透镜进行了数值模拟计算。针对本实验需求, 搭建了 LD 与光纤对光、微调平台, 以及光纤精确定点切割平台。实验测量了半导体激光器光束耦合进入普通单模光纤、105/125 0.22NA 多模光纤和 200/220 0.37NA 多模光纤等多种光纤的效率, 对于 105/125 及 200/220 多模光纤分别实现了 58% 及 89% 的最高耦合效率。验证了光纤球透镜、GIF 光纤微透镜的理论分析, 并讨论了实验中出现的现象。

**关键词:** 半导体激光器; 光纤; 光纤微透镜; BeamPROP; 耦合

**Abstract:** The combination of LD and fiber is widely used in many fields, such as optical fiber communication network, laser surgery operation in medicine and material processing. This article discusses different coupling methods by using a LD with wavelength of 980nm made by HTOE.ltd and tailors an experimental program to improve the coupling efficiency. A theoretical analysis has been introduced to exercise the idea and program of improve the coupling efficiency. BeamPROP is used to demonstrate the numerical simulation of cylindrical lens, ball lens and GIF optical lens. In order to meet the experimental needs, platform for alignment and fine adjustment between LD and optical fiber have been built, and also platform for cutting optical fiber precisely. Monitor the coupling efficiency during the operation of coupling the optic beam into different optical fibers, such as SMF, 105/125 0.22NA MMF or 200/220 0.37NA MMF, for the 105/125 and 200/220 MMF, we achieved the coupling efficiency as high as 58% and 89% respectively. The result of experiment validates the feasibility of the analyzing about theory of lensed-fiber, GIF fiber and so on. In the mean time, this article also did some correlative discussion about phenomenon which present during the experiment.

**Key Words:** LD; optical fiber; lensed-fiber; BeamPROP; coupling

**教师点评:** 论文主要研究利用光纤透镜实现半导体激光器到光纤的全光纤耦合, 为当前产业界及科研中各种 LD 到光纤的耦合提供一种简单易行、低成本的方案。对 LD 到光纤的光纤球透镜及梯度折射率光纤透镜耦合进行了理论计算, 证实了其可行性; 同时利用 Beamprop 软件对其耦合过程中的各个参数对耦合效率的影响进行了模拟分析; 设计并搭建了全光纤耦合及定点切割的实验平台; 对 976 nm LD 的光束进行了整形, 并与 200-220 及 105-125 多模光纤进行了全光纤耦合的实验研究, 分别实现了 89% 及 58% 的最高耦合效率。论文选题有很强的应用价值, 难度偏难, 文献材料收集翔实, 工作量饱满, 设计合理有一定的创新, 方案可行, 数据合理, 书写规范, 条理清晰。值得一提的是该同学从大二开始就积极进入实验室参与实验项目, 通过两年的锻炼学习, 理论基础扎实, 具有较强的实验技能, 目前已初步形成独立分析问题、解决问题的科研能力, 毕业设计中, 工作努力, 积极认真、很好地完成了毕业设计任务。是一篇优秀的毕业论文。