光学精密工程 » 2015, Vol. 23 » Issue (10): 2755-2760 DOI: 10.3788/OPE.20152310.2755

LD端面泵浦铯蒸气激光器的模式匹配

谢冀江[1], 徐艳[1,2], 陈飞[1], 杨贵龙[1], 李殿军[1], 王春锐[1], 张阔[1], 郑长彬[1], 高飞[1,2]

1. 中国科学院 长春光学精密机械与物理研究所 激光与物质相互作用国家 重点实验室, 吉林长春 130033;
2. 中国科学院大学, 北京 100049

Mode matching of LD-end-pumped cesium vapor laser

XIE Ji-jiang[1], XU Yan[1,2], CHEN Fei[1], YANG Gui-long[1], LI Dian-jun[1], WANG Chun-rui[1], ZHANG Kuo[1], ZHENG Chang-bin[1], GAO Fei[1,2]

1. State Key Laboratory of Laser Interaction with Matter, Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun 130033, China;
2. University of Chinese Academy of Sciences, Beijing 100049, China

摘要 以光纤耦合半导体激光器作为泵浦源,5 mm长的铯蒸气池作为激光增益介质,开展了端面泵浦铯蒸气激光器的模式匹配实验研究。分析了泵浦光聚焦光斑半径和聚焦位置对铯激光输出性能的影响。以激光器的工作斜效率和光光效率为指标对各模式匹配参数进行了优化,同时对激光器的阈值泵浦功率进行了研究。结果表明:在一定的激光振荡模束腰下,存在最佳的泵浦光聚焦光斑半径使斜效率最大。此外,聚焦位置在蒸气池中央时有利于提高斜效率和光光效率。对阈值泵浦功率的研究显示,阈值泵浦功率随泵浦光聚焦光斑半径的减小而减小,而且当泵浦光聚焦于蒸气池前端时有利于降低阈值泵浦功率。基于以上研究,获得了一组最佳模式匹配参数,即泵浦光聚焦光斑半径为333 μm, 激光振荡模束腰为167 μm,泵浦光聚焦位置位于蒸气池中央。

关键词 : 半导体泵浦碱金属蒸气激光器, 铯蒸气, 端面泵浦, 模式匹配

Abstract : By employing a fiber-coupled diode-laser as the pump source and a 5 mm long cesium vapor cell as laser media, the experiments on the mode-matching of a LD-end-pumped cesium vapor laser were investigated. The effects of the focus spot radius and the position of focused pump light on the output characteristics of cesium laser were analyzed. Then, the different mode-matching parameters were optimized to allow the slope efficiency and optical-to-optical efficiency to be maximal. Furthermore, the threshold pump power of the laser was studied. Results show that there is an optimal focused spot radius to allow the slope efficiency to be the highest when the laser resonant mode beam is constant. Moreover, it is beneficial to improve the efficiency when the focused spot position is in the center of vapor cell. The threshold pump power was also researched, which shows the power can decrease with decreasing the focus spot radius of pump light, and when the pumping light focuses on the front of the vapour cell, the pumping power can be reduced. Finally, a series of parameters were optimized at the laser mode waist of 167 μm, and they are focused spot radius of 333 μm, spot position of 2.5 mmm and the focusing position of pumping light on the center of the vapour cell.

Key words : Diode-pumped Alkali Vapor Laser(DPAL) cesium vapor end-pumped mode-matching

收稿日期: 2014-10-15

中图分类号: TN248.2

基金资助:国家自然科学基金资助项目(No.61308050);激光与物质相互作用国家重点实验室自主及开放研究基金资助项目(No.SKLLIM1210-01,No.SKLLIM1210-02)

作者简介: 谢冀江(1950-),男,江苏镇江人,学士,研究员,硕士生导师,1983年于哈尔滨科学技术大学获得学士学位,主要从事激光器及其应用技术方面的研究。Email:laserxjj@163.com徐艳(1988-),女,陕西西安人,硕士研究生,2012年于西北工业大学获得学士学位,主要从事碱金属蒸气激光器方面的研究。Email:18792410097@163.com

引用本文:

谢冀江, 徐艳, 陈飞, 杨贵龙, 李殿军, 王春锐, 张阔, 郑长彬, 高飞. LD端面泵浦铯蒸气激光器的模式匹配[J]. 光学精密工程, 2015, 23(10): 2755-2760. XIE Ji-jiang, XU Yan, CHEN Fei, YANG Gui-long, LI Dian-jun, WANG Chun-rui, ZHANG Kuo, ZHENG Chang-bin, GAO Fei. Mode matching of LD-end-pumped cesium vapor laser. Editorial Office of Optics and Precision Engineering, 2015, 23(10): 2755-2760.

链接本文:

http://www.eope.net/CN/10.3788/OPE.20152310.2755 或 http://www.eope.net/CN/Y2015/V23/I10/2755