量子电子学报 2013, 30(6) 690-695 DOI: ISSN: 1007-5461 CN: 34-1163/TN

激光技术与器件

正切平方势阱中线性和三阶非线性光学吸收系数的计算

周丽萍, 于凤梅

仲恺农业工程学院信息学院, 广东 广州 510225

摘要:

研究了正切平方势阱中的子带光吸收,用量子力学中的密度矩阵算符理论和迭代法推导出了正切平方势阱中线性和三阶非线性光学吸收系数的解析表达式,并以典型的GaAs/AlGaAs正切平方量子阱为例进行数值计算。计算结果表明,该势阱中的势阱宽度*b*、势阱深度V_0和入射光强*I*对吸收系数有很大影响。随着势阱宽度*b*的增加和势阱深度V_0的减小,总吸收系数的峰值减小并且向低能方向移动。随着入射光强*I*的增加,总吸收系数会减小,出现了光饱和吸收现象,同时吸收谱线的线宽随着入射光强的增大而增大。

关键词: 非线性光学 光吸收系数 密度矩阵方法 正切平方势阱

Calculation of linear and three-order nonlinear optical absorptions in square tangent quantum well

ZHOU Li-ping,~~ YU Feng-mei

College of Information, Zhongkai University of Agriculture and Engineering, Guangzhou510225, China

Abstract:

Analytic expression for the linear and third-order nonlinear optical absorption coefficients was obtained in square tangent quantum well by the compact density-matrix method and the iterative procedure. The numerical results for typical GaAs/AlGaAs material show that the well width *b*, well depth V_0 and incident intensity *I* have great influence on the absorption coefficients and the total optical absorption coefficients are induced with the enhancement of *b* and the reduction of V_0. It is obtained that the peak absorption shift to the aspect of the low energy. Moreover, the peak of the total optical absorption coefficients is significantly induced and the strong absorption saturation will occur with increasing of the incident intensity.

Keywords: nonlinear optics optical absorption coefficients density-matrix approach square tangent quantum well

收稿日期 2012-12-14 修回日期 2013-02-21 网络版发布日期

DOI:

基金项目:

广东高校优秀青年创新人才培养计划项目资助(LYM11077)

通讯作者:

作者简介: 周丽萍(1978 -),女,河南驻马店人,硕士,讲师,主要从事凝聚态物理的研究。

作者Email:

参考文献:

[1] Dingle R, Wiegmann W, Henry C H. Quantum states of confined carries in very thin AlxGa1-xAs-As-GaAs-AlxGa1-xAs heterostructures[J]. Phys.Rev.Lett, 1974,33(7):827-833.
[2] Ahn.D and Chuang.S.L. Intersubband optical absorption in a quantum well with an

applied electric fiele[J]. Phys.Rev.B, 1987,35:4149-4151. [3] Cui Da-fu, Chen Zhang-hao, Pan Shao-hua, et al. Absorption saturation of intersubband optical transitons in GaAs/ AlxGa1-xAs multiple quantum wells [J]. Phys.Rev.B, 1993,47:6755-6758. [4] Pan Shaohua, Feng Simin. General formalism of the Krouging-Penncy model suitable for supperlattice applications [J]. Phys.Rev.B, 1991,44:5668-5671. [5] Guo Kangxian and Chen Chuanyu. Exctionic effects on the nonlinear optical absorptions in hyperbolic quantum wires[J]. Acta Photonica Sinica（光子学报）, 2000,29(6):501-505. [6] 刘翠红, 陈传誉, 马本昆. 极化子效应对量子盘中线性和非线性光吸收系数的影响[J]. 物理学报, 2002,51(9):2022-2028. [6] Liu Cuihong, Chen Chuanyu, Ma Benkun. Polaron effects on linear and nonlinear optical absorption coefficients in a quantum disk[J]. Acta Physica Sinica, 2002,51(9):2022-2028. [7] Zhang Li. Studies on the Third-order Nonlinear Optical Properties of a Quantum Dot Quantum well[J]. Acta Sinica Quantum Optica（量子光学学报）, 2003,10(1):5-10. [8] Zhang Li, Xie Hongjing. Linear and Nonlinear Optical Absorptions in Semiparabolic Quantum Wells [J]. Journal of Optoelectroics?Laser（光电子?激光）, 2004,15(11)：1379-1383. [9] KARIMI M J, KESHAVARZ A, POOSTFORUSH A. Linear and Nonlinear Intersubband optical Absorption and Refractive Index Changes of Asymmetric Double Semi-parabolic Quantum Wells[J]. Superlattices and Microstrctures, 2011,49:441-452. [10] 胡西多,邵明珠,罗诗裕. 正切平方势单量子阱的本证值和本证函数[J]. 发光学报, 2006,27(5):656-660. [10] Hu Xiduo, Shao Mingzhu,Luo Shiyu. Tan2x Potential and Eigenvaluenand Eigenfunction for Single Quantum Well [J]. Chin.J.Lumin, 2006,27(5):656-660. [11] Kuhn K J, Lyengar G U, Yee S. Free carrier induced changes in changes in the absorption and refractive index for intersubband optical transitions in AlxGaAs1-x/GaAs/ AlxGaAs1-x quantum wells[J]. J.Appl.Phys, 1991,70(9):5010-5017. [12] 王光辉, 郭康贤, 郭旗. 非对称量子阱中线性和三阶非线性光吸收系数的研究. 量子电子学报, 2004,21(4):429-433. [12] Wang Guanghui, Guo Kangxian and Guo Qi. Study on linear and third-order nonlinear optical absorptions in special asymmetric quantum wells [J]. Chinese Journal of Quantum Electronics, 2004,21(4):429-433. [13] 陈知红, 郑丹, 方天红. ZnS/CdSe量子点中线性和三阶非线性光吸收系数研究. 量子光学学报, 2012,18(3):280-285. [13] CHEN Zhi-hong, ZHENG Dan, FANG Tian-hong. Linear and Nonlinear Optical Absorptions in a ZnS/CdSe Quantum Dot Quantum wells [J]. Acta Sinica Quantum Optica, 2012,18(3):280-285.

本刊中的类似文章

1．马会芳 杨性愉 .负折射介质中高阶非线性效应所致啁啾的研究[J]. 量子电子学报, 2009,26(3): 346-351

2．李华刚.三维自散焦介质中交叉传输的光束诱导聚焦[J]. 量子电子学报, 2009,26(3): 352-355

3．张少武 易林.广义非局域非线性薛定谔模型的自相似解[J]. 量子电子学报, 2009,26(4): 465-472

4．刘安玲 张为俊 高晓明.着色丙酮中受激热散射和纯丙酮中受激布里渊散射的频率响应[J]. 量子电子学报, 0,(): 475-478

5．刘安玲 张为俊 高晓明.着色丙酮中受激热散射和纯丙酮中受激布里渊散射的频率响应[J]. 量子电子学报, 2009,26(4): 473-476

6．金铱 陈宪锋 黄正逸 沈小明 蒋美萍.非线性微腔的光学双稳态[J]. 量子电子学报, 2009,26(5):