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光谱

纤锌矿应变GaN柱形量子点中离子受主束缚激子的带间光跃迁

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摘要：

在有效质量近似基础上，考虑强的内建电场效应，变分计算了纤锌矿结构的GaN柱形量子点中带电量为 的离子受主束缚激子(A?, X)的发光波长。结果表明，离子受主束缚激子发光波长强烈依赖于量子点的尺寸（高度和半径）、离子受主杂质的位置和垒中Al含量。随着量子点高度、半径及垒中Al含量的增加，离子受主束缚激子发光波长增大。随着离子受主杂质从量子点左边垒中沿z轴方向移至量子点左边界时，发光波长先增大，在量子点的左界面附近达到极大值；随着离子受主杂质在量子点内继续右移，发光波长减小，当杂质位于量子点的右边界附近时光跃迁波长达到极小值；进一步右移离子受主杂质至量子点的右边垒中时，发光波长增大。和自由激子光跃迁波长相比，当离子受主杂质位于量子点中心的左边时，杂质的引入使发光波长增大，当离子受主杂质位于量子点中心的右边时，杂质的引入使发光波长减小。

关键词： 光电子学 柱形量子点 内建电场 离子受主束缚激子 发光波长

Interband optical transitions due to ionized acceptor bound excitons in wurtzite GaN strained cylindrical quantum dot

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Abstract:

Considering the strong built-in electric field(BEF) in the wurtzite cylindrical GaN quantum dot(QD) with finite potential barriers, the interband optical transitions due to the exciton bound by an ion with charge ? e (called ionized acceptor bound exciton (A?, X)) are investigated theoretically by means of a variational method. Numerical results show that the emission wavelengths sensitively depend on the QD size(L and R), the position of the ionized acceptor and the Al composition x of the barrier material AlxGa1-xN. The transition wavelength is increased if the QD height, the QD radius and Al composition x are increased. The emission wavelength firstly increases when the ionized accptor is moved from the left barrier of the QD to right along z-direction, and reaches its maximum when the acceptor is in the vicinity of the left interface of the QD. Then the transition wavelength decreases if the acceptor is continuously moved toward right. The minimum value of the transition wavelength can be obtained when the acceptor is in the vicinity of the right interface of the QD. The wavelength is increased again if the acceptor is further moved to the right barrier of the QD. The emission wavelength increases when the acceptor position goes from the center of the QD. Comparing with the free exciton state without the acceptor, the emission wavelength increases with introducing the ionized accptor impurity into the left side of the QD center, and the emission wavelength reduces with introducing the ionized accptor impurity into the right side of the QD center.

Keywords: optoelectronics cylindrical quantum dot built-in electric field ionized acceptor bound exciton emission wavelength

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