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### 材料合成及性能

#### 电子束泵浦ZnO/ZnMgO量子阱的最佳激发电压

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摘要： 对不同加速电压电子束泵浦下的ZnO/Zn<sub>0.85</sub>Mg<sub>0.15</sub>O量子阱的荧光光谱进行了研究。样品利用分子束外延技术在蓝宝石衬底上生长。激子隧穿使非对称双量子阱的激发效率相对于对称阱有了明显提高。非对称阱的结构设计使最佳激发电压从对称阱的7 kV降低到了更适合器件小型化的5 kV。

关键词： ZnO 量子阱 电子束泵浦 激子隧穿

#### Decrease of Optimal Accelerating Voltage of ZnO-based Quantum Wells Pumped by Electron Beam

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Abstract: Cathodoluminescence behavior vs. accelerating voltage of electron beam in ZnO/ZnMgO multi-quantum wells was reported in this paper. The samples were grown on sapphire substrate by plasma-assisted molecular beam epitaxy. By exciton tunneling, the excitation efficiency was improved significantly. In a sample with asymmetric double-quantum-wells, a marked reduction of the optimal acceleration voltage from 7 kV to 5 kV was obtained compared to the symmetrical multi-quantum well sample.

Keywords: ZnO quantum wells electron beam pumped exciton tunneling

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#### 参考文献:

- [1] Oto T, Banal R G, Kataoka K, *et al.* 100 mW deep-ultraviolet emission from aluminium-nitride-based quantum wells pumped by an electron beam[J]. *Nat. Photon.* [crossref](#)
- [2] Gronin S V, Sorokin S V, Sedova I V, *et al.* ZnSe-based laser structures for electron-beam pumping with graded index waveguide[J]. *Phys. Status Solidi (c)*.2010, 7(6): 1694-1696 [crossref](#)
- [3] Watanabe K, Taniguchi T, Niiyama T, *et al.* Far-ultraviolet plane-emission handheld device based on hexagonal boron nitride[J]. *Nat. Photon.* [crossref](#)
- [4] Watanabe K, Taniguchi T, Kanda H. Direct-bandgap properties and evidence for ultraviolet lasing of hexagonal boron nitride single crystal[J]. *Nat. Mater.* [crossref](#)
- [5] Gruber T, Kirchner C, Kling R, *et al.* ZnMgO epilayers and ZnO-ZnMgO quantum wells for optoelectronic applications in the blue and UV spectral region[J]. *Appl. Phys. Lett.* [crossref](#)
- [6] Su S C, Lu Y M, Zhang Z Z, *et al.* Valence band offset of ZnO/Zn<sub>0.85</sub>Mg<sub>0.15</sub>O heterojunction measured by X-ray photoelectron spectroscopy[J]. *Appl. Phys. Lett.* [crossref](#)
- [7] Sun J W, Lu Y M, Liu Y C, *et al.* Room temperature excitonic spontaneous and stimulated emission properties in ZnO/MgZnO multiple quantum wells grown on sapphire substrate[J]. *J. Phys.D.*2007, 40 (21): 6541-6544 [crossref](#)
- [8] Wei Z P, Lu Y M, Shen D Z, *et al.* Effect of interface on luminescence properties in ZnO/MgZnO heterostructures[J]. *J. Lumin.* [crossref](#)
- [9] Ye J D, Zhao H, Liu W, *et al.* Theoretical and experimental depth-resolved cathodoluminescence microanalysis of excitonic emission from ZnO epilayers[J]. *Appl. Phys. Lett.* [crossref](#)
- [10] Kanaya K, Okayama S. Penetration and energy-loss theory of electrons in solid targets[J]. *J. Phys.*

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- [11] Drouin D, Couture A R, Joly D, *et al.* CASINO V242: A fast and easy-to-use modeling tool for scanning electron microscopy and microanalysis users[J].. *Scanning* [crossref](#)
- [12] Yu G Y, Fan X W, Zhang J Y, *et al.* The exciton tunneling in ZnCdSe/ZnSe asymmetric double quantum well [J]. *J. Electron. Mater.* [crossref](#)
- [13] Yu G Y, Fan X W, Zhang J Y, *et al.* Laser action in ZnCdSe/ZnSe asymmetric double-quantum-well[J]. *Solid State Commun.* [crossref](#)
- [14] Su S C, Lu Y M, Xing G Z, *et al.* Spontaneous and stimulated emission of ZnO/Zn<sub>0.85</sub>Mg<sub>0.15</sub>O asymmetric double quantum wells[J].. *Superlattices and Microstructures* [crossref](#)