光子学报 2012, 41(10) 1242-1246 DOI: 10.3788/gzxb20124110.1242 ISSN: 1004-4213 CN: 61-1235/O4

论文

Zn掺杂β-Ga_2O_3薄膜的制备和特性研究

赵银女

鲁东大学教务处, 山东 烟台 264025

摘要:

β-Ga_2O_3是一种宽带隙半导体材料,能带宽度E_g≈5.0eV,在光学和光电子学领域有广泛的应用。用射频磁控溅射方法在Si衬底和远紫外光学石英玻璃衬底制备了本征β-Ga_2O_3薄膜及Zn掺杂β-Ga_2O_3薄膜,用紫外 可见分光光度计、X射线衍射仪、荧光分光光度计对本征β-Ga_2O_3薄膜及Zn掺杂β-Ga_2O_3薄膜的光学透过、光学吸收、结构和光致发光进行了测量,研究了Zn掺杂和热退火对薄膜结构和光学性质的影响。退火后的β-Ga_2O_3薄膜为多晶结构,与本征β-Ga_2O_3薄膜相比,Zn掺杂β-Ga_2O_3薄膜的β-Ga_2O_3(111)衍射峰强度变小,结晶性变差,衍射峰位从35.69° 减小至35.66° 。退火后的Zn掺杂β-Ga_2O_3薄膜的光学带隙变窄,光学透过降低,光学吸收增强,出现了近边吸收,薄膜的紫外、蓝光及绿光发射增强。表明退火后Zn掺杂β-Ga_2O_3薄膜中的Zn原子被激活充当受主。

关键词: Zn掺杂β-Ga_2O_3 光学透过 光学带隙 光致发光

Preparation and Properties of Zn-doped β-Ga_2O_3 Films

ZHAO Yin-nü

Dean's Office, Ludong University, Yantai, Shandong 264025, China

Abstract:

β-Ga_2O_3 is a wide band gap semiconductor with a band gap of E_g≈5.0eV,which has potential optical and optoelectronic applications.The intrinsic β-Ga_2O_3 and Zn-doped β-Ga_2O_3 films were prepared on Si(111) and UV transparent quartz substrates using RF magnetron sputtering.The optical transmission,optical absorption,structural property,photoluminescence were measured using adouble beam spectrophotometer,X-ray diffractometer,fluorescence spectrometer.The effects of the Zn doping and thermal annealing on the structural and optical properties were investigated.The post-annealed β-Ga_2O_3 films are polycrystalline.In comparison with the intrinsic β-Ga_2O_3 films,the intensity of the Zn-doped β-Ga_2O_3 (111) peak becomesweak,the crystallization deteriorates,the (111) peakposition shifts from 35.69° to 35.66° . For the post-annealed Zn-doped β-Ga_2O_3 films,the optical band gap shrinks,the transmittance decreases,the absorption increases,the near-edge absorption appears,and the UV,blue,greene mission bands are enhanced.It means that the doped Zn atoms are activated effectively after annealing and act as acceptors.

Keywords: Zn-doped β-Ga_2O_3 Optical transmittance Optical band gap Photoluminescence

收稿日期 2012-04-19 修回日期 2012-07-02 网络版发布日期

DOI: 10.3788/gzxb20124110.1242

基金项目:

The National Natural Science Foundation of China(No.10974077);Natural Science Foundation of Shandong Province,China (No.2009ZRB01702) and Shandong Province Higher Educational Science and Technology Program(No.J10LA08)

通讯作者:

作者简介:

参考文献:

[1] ORIT A M,HIRAMATSU H,OHTA H,*etal*.Preparation of highly conductive,deep ultraviolet transparent β-Ga_2O_3 thin film at low deposition temperatures[J].*Thin Solid Films*,2002,411(1):134-139.

[2] LIU Jian-jun,YAN Jin-liang,SHI Liang,*et al*.Electrical and optical properties of deep ultraviolet transparent conductive Ga_2O_3/ITO films by magnetron sputtering[J].Chinese Journal of Semiconductors,2010,31(10):103001-5.

[3] KIM K S,KIM H W,LEE C M.Effect of growth temperature on ZnO thin film deposited on SiO_2 substrate[J].*Materials Science and Engineering B*,2003,98(2):135-139.

[4] YAN Jin-liang,ZHANG Yi-jun,LI Qing-shan,*etal*.Optical properties of N-doped β-Ga_2O_3 films deposited by RF magnetron sputtering[J].Acta Photonica Sinica,2011,40(6):852-856.

[5] YAN Jin-liang,ZHAO Yin-nü.Optical properties of Cu-doped β-Ga_2O_3 thin films[J].Acta Photonica Sinica,2012,41(6):704-707.

[6] YAN Jin-liang,ZHAOY in-nü.Electronic structure and optical properties of N-Znco-doped β-Ga_2O_3 [J].*Science in China Series G:Physics,Mechanics and Astronomy*<、*em*>,*2012,55(4):1-6.*

[7] ZHANG J G,XIA C G,DENG Q.Growth and characterization of new transparent conductive oxides single crystals β-*Ga_2O_3:Sn[J].Journal of Physics and Chemistry Solids,2006,67(8):1656 ‐1659.*

[8] KIYOSHI S,ENEAMNACION G,VILLORA,etal.Excitation and photoluminescence of pureand Si-doped β-Ga_2O_3 single crystals[J].Applied Physics Letters,2008,92(20):201914-3.
[9] SUZUKI N,OHIRA S,TANAKA M,etal.Fabrication and characterization of transparent conductive Sn-doped β-Ga_2O_3 singlecrystal[J].Physical Status Solidi,2007,4(7):2310-2313.
[10] ZHANG Li-ying,YAN Jin-liang,ZHANG Yi-jun,etal.Acomparison of electronic structure and optical properties between N-doped β-Ga_2O_3 and N-Zn co-doped β-Ga_2O_3[J].Physica B,2012,407(8):1227-1231.
[11] HAO J,COCIVERA M.Optical and luminescent properties of undoped and rare earth doped Ga_2O_3 thin films deposited by spray pyrolysis[J].Journal of Physics D,2002,35(5):433-439.
[12] Al-KUHAILI M F,DURRANI S M A,KHAWAJA E E.Optical properties of gallium oxide films deposited by electron-beam evaporation[J].Applied Physics Letters,2003,83(22):4533-4537.
[13] SHIMAMURA,VILLORA K,UJIIEEG,etal.Excitation and photoluminescence of pure and Si-doped β-Ga_2O_3 single crystals [J].Applied Physics Letters,2008,92(20):201914-201918.

本刊中的类似文章

1．李宏光.NH_3-Ar气氛下制备的Zn_3N_2薄膜的结构和光学性能[J]. 光子学报, 2012,(6): 695-699

2．闫金良, 赵银女.Cu掺杂Ga_2O_3薄膜的光学性能[J]. 光子学报, 2012,(6): 704-707

3．王永辉, 陈芬, 王国祥, 沈祥, 周亚训, 李军, 戴世勋.新型$GeSe_2$-In_2Se_3-AgI玻璃性能研究[J]. 光子学报, 2012,(6): 718-722

4．王爱华, 吕林霞, 宋海珍, 宋金璠, 包特木尔巴根, 卢成.不同条件制备的ZnO纳米梳结构及其性能研究[J]. 光子学报, 2012,(6): 728-731

5．李建勇;王丽阁;李成仁;刘中凡;宋昌烈.镱铒共掺Al2O3薄膜光致发光特性优化[J]. 光子学报, 2006,35(11): 1746-1751

6．黄远明 翟保改 周甫方 .SiO2薄膜中咔唑的发光特性[J]. 光子学报, 2007,36(4): 719-721

7．宋国利;梁红.ZnO：Tb3+纳米晶的制备及发光性质研究[J]. 光子学报, 2006,35(10): 1589-1592

8．杨彗;顾培夫;叶辉;杨立功.聚合物MO-PPV薄膜光致发光特性研究[J]. 光子学报, 2006,35(10): 1555-1559

9．袁艳红;侯洵;白晋涛.紫外光激发下氧化锌纳米线的发光特性研究[J]. 光子学报, 2006,35(3): 373-376

10．宋国利;孙凯霞.纳米ZnO薄膜的光致发光性质[J]. 光子学报, 2005,34(4): 590-593

11．惠战强;侯榆青;任兆玉;曹国雄;任宽芳;白晋波.多孔氧化铝膜的荧光研究[J]. 光子学报, 2005,34(10): 1522-1525

12．闫金良.多孔氧化铝薄膜的制备和光学特性研究[J]. 光子学报, 2005,34(10): 1530-1533

13．闫金良,张易军,李清山,曲崇,张丽英,李厅.射频磁控溅射法制备N掺杂β-Ga2O3薄膜的光学特性[J]. 光子学报, 2011,40(6): 852-856

14．王兴军;曹保胜;雷明凯.Sol-gel法制备Er^{3+}-Yb^{3+}共掺杂Al_2O_3粉末光致发光特性[J]. 光子学报, 2004,33(8): 935-938

15．兰燕娜;杜银霄;朱会丽;董华;高影;莫育俊.多孔硅在30~180℃温区光致发光谱的研究[J]. 光子学报, 2004,33(12): 1461-1464

文章评论（请注意:本站实行文责自负，请不要发表与学术无关的内容!评论内容不代表本站观点.）

反馈人		邮箱地址	
反馈标题		验证码	6725