光子学报 2012, (6) 695-699 DOI: 10.3788/gzxb20124106.0695 ISSN: 1004-4213 CN: 61-1235/O4

论文

NH_3-Ar气氛下制备的Zn_3N_2薄膜的结构和光学性能

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摘要:

Zn_3N_2是一种宽带隙半导体材料,在温度高于400°C氧化可生成p型ZnO:N,p型ZnO:N在电子学和光电子学领域有广泛的应用.在NH_3-Ar气氛下,用RF磁控溅射金属Zn靶在玻璃衬底上室温制备了Zn_3N_2薄膜.用紫外-可见分光光度计、X射线衍射仪、X射线光电子谱分析仪、荧光分光光度计对Zn_3N_2薄膜的光学透过、光学吸收、结构、化学键态和光致发光进行了测量,研究了NH_3分压对Zn_3N_2薄膜的结构和光学特性的影响.XRD分析表明Zn_3N_2薄膜呈现多晶结构,具有(321)择优取向,Zn_3N_2 (321)衍射峰强度随NH_3分压增加而增强.在NH_3分压5%~10%制备的Zn_3N_2薄膜有较低透过率,透过率随NH_3分压增加而提高. Zn_3N_2薄膜是间接带隙半导体,当NH_3分压从5%变化到25%时,光学带隙从2.33 eV升高到2.70 eV. XPS分析表明Zn_3N_2薄膜在潮湿空气中容易水解.室温下Zn_3N_2薄膜在437 nm和459 nm波长出现了发光峰.

关键词: Zn_3N_2薄膜 磁控溅射 NH_3分压 光致发光

Structural and Optical Properties of Zn_3N_2 Films Prepared by Magnetron Sputtering in NH_3-Ar Mixture Gases

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Abstract:

The Zn_3N_2 is a kind of wide band gap semiconductor and it can be converted into p-type ZnO:N after oxidation at temperatures higher than 400癈 which has significant potential for electronic and optoelectronic applications. The Zn_3N_2 films were prepared by RF magnetron sputtering a metallic zinc target in NH_3-Ar mixture gases on glass substrate at room temperature. The optical transmission, optical absorption, structural property, chemical bonding states, photoluminescence were measured using a double beam spectrophotometer, X-ray diffractometer (XRD), X-ray Photoelectron Spectroscopy (XPS), fluorescence spectrometer. The effects of NH_3 ratio on the structural and optical properties of the films were examined. XRD analysis indicates that the films are polycrystalline and have a preferred orientation of (321). The intensity of the Zn_3N_2 (321) peak increases with the NH_3 ratio. The films prepared with the NH_3 ratios of 5%~10% have low transmission values, the transparency of the films get better with the increase of the NH_3 ratio. The Zn_3N_2 films have an indirect band gap, the optical band gap increases from 2.33 to 2.70 eV when the NH_3 ratio varies from 5% to 25%. XPS analysis shows that the Zn_3N_2 film is easily hydrolyzed by air moisture. Photoluminescence spectrum shows two emission peaks, which are located at 437 nm and 459 nm.

Keywords: Zinc nitride films Magnetron sputtering NH_3 ratios Photoluminescence

收稿日期 2011-11-21 修回日期 2012-01-16 网络版发布日期

DOI: 10.3788/gzxb20124106.0695

基金项目:

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

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