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器件制备技术及器件物理

反应溅射法制备氮化铝薄膜及工作气压对其场发射性能的影响

李松玲, 王如志, 赵维, 王波, 严辉

北京工业大学 材料科学与工程学院, 北京 100124

摘要: 采用反应磁控溅射法在不同工作气压(0.5~2.0 Pa)下沉积了一系列氮化铝(AIN)薄膜。研究发现,在保持其他工艺参数不变的条件下,工作气压对薄膜厚度的影响很小。场发射性能测试表明,在较低的工作气压(0.5 Pa和0.7 Pa)下制备的AIN薄膜具有一定的场发射性能。扫描电子显微镜(SEM)图像显示,在较高的工作气压(2.0 Pa)下制备的薄膜易产生空位及微空洞等缺陷,使薄膜致密性下降。电子在薄膜中的输运因受到缺陷的散射而不能隧穿表面势垒进行发射。研究表明,为获得具有良好场发射性能的AIN薄膜,若采用反应磁控溅射法,应选取较低的工作气压;同时,对于薄膜型阴极,具有紧密晶粒结构及较小缺陷的薄膜可能具有更优异的场发射性能。

关键词: 氮化铝薄膜 场发射 工作气压 缺陷

Effects of Pressure on Field Emission Characteristics of AlN Thin Films Prepared by RF Reactive Magnetron Sputtering

LI Song-ling, WANG Ru-zhi, ZHAO Wei, WANG Bo, YAN Hui

College of Materials Science and Engineering, Beijing University of Technology, Beijing 100124, China

Abstract: Aluminum nitride (AlN) thin films were prepared by radio frequency (RF) reactive magnetron sputtering at the pressure ranging from 0.5 Pa to 2.0 Pa. Keeping the invariant process parameters, the thickness of the films changed very small by changing the working pressure. The field emission (FE) measurement showed that the FE current can be observed only for these films prepared under the lower work pressure 0.5 Pa and 0.7 Pa. The scanning electron microscope (SEM) images showed that the films prepared with higher working pressure (2.0 Pa) are easy to form vacancy and micro-voids. Then electrons transport in the films will be scattered by the defects and can't tunneling through surface barrier and no FE appearing. It suggests that for AlN films prepared by RF reactive magnetron sputtering, to get excellent FE properties, a lower pressure may be better. The study also indicates that the films with more compact grains and smaller defects may have excellent FE properties.

Keywords: AlN films field emission working pressure defects

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通讯作者: E-mail: wrz@bjut.edu.cn

作者简介: 李松玲(1982-),女,内蒙古牙克石人,硕士研究生,主要研究方向是半导体薄膜的场电子发射。

作者Email: wrz@bjut.edu.cn

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