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采用热丝化学气相沉积法制备SiCN薄膜的研究

赵武, 屈亚东, 张志勇, 袁江妮, 樊玎玎

(西北大学 信息科学与技术学院, 陕西 西安, 710127)

摘要: 采用热丝化学气相沉积(HFCVD)系统, 在单晶Si衬底上制备SiCN薄膜。所采用的源气体为高纯的SiH₄, CH₄和N₂。用原子力显微镜(AFM)、X线衍射谱(XRD)和X线光电子能谱(XPS)对样品进行表征与分析。研究表明: SiCN薄膜表面由许多粒径不均匀、聚集紧密的SiCN颗粒组成; 薄膜虽然已经晶化, 但晶化并不充分, 存在着微晶和非晶成分, 通过Jade软件拟合计算出薄膜的结晶度为48.72%; SiCN薄膜不是SiC和Si₃N₄的简单混合, 薄膜中Si, C和N这三种元素之间存在多种结合态, 主要的化学结合状态为Si—N, Si—N—C, C—N, N=C和N—Si—C键, 但是, 没有观察到Si—C键, 说明所制备的薄膜形成了复杂的网络结构。

关键字: SiCN薄膜; 热丝化学气相沉积法(HFCVD); 原子力显微镜(AFM); X线衍射谱(XRD); X线光电子能谱(XPS)

Silicon carbon nitride thin film produced by hot-filament chemical vapor deposition

ZHAO Wu, QU Ya-dong, ZHANG Zhi-yong, YUN Jiang-ni, FAN Ding-ding

(Information Science and Technical Institute, Northwest University, Xi'an 710127, China)

Abstract: The silicon carbon nitride (SiCN) thin film was synthesized on Si substrate by hot-filament chemical vapor deposition (HFCVD) with the source gas of SiH₄, CH₄ and N₂. The sample was characterized by atomic force microscope (AFM), X-ray diffraction spectroscopy (XRD) and X-ray photo-emission spectroscopy (XPS). The results show that the surface of the SiCN thin film is composed of a lot of grains which have different sizes and accumulate close. The thin film is crystallized, but crystallization is not complete, having the microcrystalline and the amorphous ingredient, and the fitting is 48.72% by Jade software. SiCN film is not simple mixed by SiC and Si₃N₄, and Si, C and N in the thin film have many kinds of combination conditions among which the main combination conditions are Si—N, Si—N—C, C—N, N=C and N—Si—C bonds, but the Si—C bonds are absent. It can be concluded that the complex network architecture is formed in the thin film.

Key words: SiCN thin film; hot-filament chemical vapor deposition; atomic force microscope; X-ray diffraction spectroscopy; X-ray photo-emission spectroscopy

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地 址：湖南省长沙市中南大学 邮 编： 410083

电 话： 0731-88879765 传 真： 0731-88877727

电子邮箱： zngdxb@mail.csu.edu.cn 湘ICP备09001153号