

反应堆工程

射频磁控溅射法制备氧化铝涂层绝缘性能及吸氢特性

宋斌斌¹; 吴平^{1, *}; 陈森¹; 巨新¹; 赵以德²; 张师平¹; 闫丹³; 李新连¹

1.北京科技大学 应用学院, 北京100083 2.兰州物理研究所, 甘肃 兰州730000 3.中微光电子有限公司, 山东潍坊261061

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摘要 氧化铝具有优良的绝缘和阻氚性能, 是ITER候选功能材料之一。本工作采用射频磁控溅射法在中国低活化马氏体 (CLAM) 钢基底上制备了氧化铝涂层。分别采用掠入射X射线衍射、Raman激光光谱和原子力显微镜对氧化铝涂层的结构和表面形貌进行了表征; 测量了氧化铝涂层体电阻率; 研究了氧化铝涂层样品的吸氢特性。结果表明: 氧氩比为0.1和0.5下制备的氧化铝涂层为非晶结构, 氧氩比为0.4下制备的涂层中出现了结晶程度较差的氧化铝 δ 相结构; 氧氩比为0.1和0.4下制备的涂层粗糙度和粒径均小于氧氩比为0.5下制备的涂层; 不同氧氩比下制备的氧化铝涂层体电阻率均超过 $2.7 \times 10^{14} \Omega \cdot \text{cm}$, 氧氩比为0.4下制备的涂层电阻率最高, 达到 $2.1 \times 10^{15} \Omega \cdot \text{cm}$; 氧氩比为0.5下制备的涂层样品具有最低的吸氢量。氧氩比对涂层的电绝缘特性和吸氢特性有显著影响。

关键词 [氧化铝涂层](#) [绝缘性能](#) [吸氢](#)

分类号

Insulating Characteristics and Hydrogen Absorption of Aluminum Oxide Coatings Deposited by RF Magnetron Sputtering

SONG Bin-bin¹; WU Ping^{1, *}; CHEN Sen¹; JU Xin¹; ZHAO Yi-de²; ZHANG Shi-ping¹; YAN Dan³; LI Xin-lian¹

1. University of Science and Technology Beijing, Beijing 100083, China; 2. Lanzhou Institute of Physics, Lanzhou 730000, China; 3. Advanced Optoelectronic Devices Co., Ltd., Weifang 261061, China

Abstract Aluminum oxide with high resistivity and tritium permeation resistance is considered as a promising candidate functional material for ITER. In this study, aluminum oxide coatings were prepared onto the China Low Activation Martensitic (CLAM) steel substrates via RF magnetron sputtering. The structure and the surface morphologies of the coatings prepared at various O_2/Ar ratios were characterized via grazing incidence X-ray diffraction, Raman spectroscopy and atomic force microscopy. The volume resistivities of the coatings were measured. The hydrogen absorption of the coating samples was also studied. The results show that the aluminum oxide coatings prepared at O_2/Ar ratios of 0.1 and 0.5 are amorphous, while the aluminum oxide coating prepared at an O_2/Ar ratio of 0.4 has a poor δ phase crystalline structure. The roughness average and the particle size of the coatings prepared at O_2/Ar ratios of 0.1 and 0.4 are smaller than those prepared at an O_2/Ar ratio of 0.5. The volume resistivities of the coatings prepared at various O_2/Ar ratios all exceed $2.7 \times 10^{14} \Omega \cdot \text{cm}$, and the coating prepared at an O_2/Ar ratio of 0.4 has the largest resistivity, reaching $2.1 \times 10^{15} \Omega \cdot \text{cm}$. The hydrogen absorption of the coating prepared at an O_2/Ar ratio of 0.5 is the smallest. The electrical insulation and hydrogen absorption properties of the aluminum oxide coatings are affected significantly by O_2/Ar ratios.

扩展功能

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