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射频磁控溅射 $Ba_{0.6}Sr_{0.4}TiO_3$薄膜表层的XPS研究

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摘要 用射频磁控溅射在Pt/Ti/SiO_2/Si基体上沉积$Ba_{0.6}Sr_{0.4}TiO_3$(BST)薄膜, 用X射线光电子能谱(XPS)研究BST薄膜表层在常规晶化和快速晶化条件下的结构特征. 结果表明, 常规晶化时, BST薄膜表层约3～5nm厚度内含有非钙钛矿结构的BST, 随着温度的升高该厚度增加; 快速晶化时, 该厚度减薄至1nm内, 随着温度的升高没有明显增加. 元素的化学态分析结果表明, 非钙钛矿结构的BST并非来自薄膜表面吸附的CO和CO_2等污染物, 而与表面吸附的其他元素(如吸附氧)对表层结构的影响有关. GXRD和AFM表明, 致密的表面结构能有效的阻止表面吸附元素在BST膜体中的扩散, 从而减薄含非钙钛矿结构层的厚度.

关键词 BST 表层 晶化 钙钛矿结构 XPS

分类号 TN304

XPS Study of the Surface Layer of Ba0.6Sr0.4TiO3 Thin Films Deposited by Radio Frequency Magnetron Sputtering

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Abstract $Ba_{0.6}Sr_{0.4}TiO_3$ (BST) thin films were deposited on Pt/Ti/SiO_2/Si substrate by radio frequency magnetron sputtering. The as-deposited films were crystallized by conventional thermal annealing (CTA) and rapid thermal annealing (RTA), respectively. The X-ray photoelectron spectroscopy (XPS) analysis show that the surface layer of the CTA-annealed film contains much non-perovskite BST phase, and has a thickness of 3～5nm approximately; while the RTA annealed surface layer contains much lower non-perovskite BST phase, and its thickness is less than 1nm. Meanwhile, with the annealing temperature increasing, the CTA-annealed surface layer increases, but for the film annealed by RTA, its thickness doesn't increase so obviously. The results also show that the formation of the non-perovskite BST phase could not be attributed to the surface adsorbate of CO or CO2, but to the elements such as oxygen. GXRD and AFM analysis manifest that the compact surface structure can effectively prevent the absorbed elements from diffusing into the BST film further, resulting in a thinner surface layer containing non-perovskite BST phase.

Key words BST surface layer crystallization perovskite structure XPS

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