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微纳技术与精密机械

锆钛酸铅薄膜的生长与表征

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摘要: 研究了如何利用溶胶凝胶法制备锆钛酸铅(Pb(Zrx,Ti1-x)O3, PZT)薄膜, 并对该薄膜的进行了表征测试。根据分子式设计了溶液的成分及配比, 配制溶液后旋涂于钛(Ti)及铂/钛(Pt/Ti)基底上。利用X射线衍射仪(XRD)和原子力显微镜(AFM)对不同热处理温度 and 不同退火温度的PZT薄膜的形貌、成分进行了表征测试。在此基础上, 采用微机电系统(MEMS)工艺, 开发了可用于测试PZT薄膜材料特性的工艺流程与测试样品。然后, 利用标准铁电测试仪对不同热处理温度和不同退火温度的PZT薄膜的极化强度进行了铁电特性测试。结果表明, 在400 °C进行热处理, 650 °C进行退火的条件下制备出的PZT薄膜其成分和形貌比较好, 铁电特性较优, 能够应用于MEMS器件与纳米器件的制造中。

关键词: 锆钛酸铅薄膜 热处理 退火 铁电特性 溶胶凝胶法

Growth and Characterization of Lead Zirconate Titanate (PZT) Thin Films

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Abstract: This paper explores how to prepare the Pb(ZrxTi1-x)O3(PZT) thin films by using the sol-gel method on a silicon substrate, then it tests the film characteristics by different methods. The solution with different compositions and proportions is designed according to the molecular formulas, and then the solution is coated on Titanium (Ti) or Platinum/Titanium (Pt/Ti) substrates. The X-ray diffraction (XRD) analysis is used to characterize the orientation and crystalline quality of the PZT thin films, and the Atomic Force Microscopy (AFM) is used to study their morphologies. The influences of different heat treatment temperatures on the crystalline quality and surface morphology are analyzed. Based on this, a Micro-electro-mechanical System (MEMS) process is developed for the PZT thin film structure to measure their ferroelectric properties, and a Sawyer tower circuit is used to measure the polarization electric hysteresis. The results show that PZT thin films prepared by the sol-gel method have good ferroelectric property and morphologies at heat treatment of 400 °C and annealing treatment of 650 °C, and can be applied to the PZT-based MEMS and nano devices.

Keywords: Lead zirconate titanate thin film heat treatment Annealing ferroelectric properties Sol-gel method

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