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半金属 Fe_3O_4薄膜的制备工艺探索

唐晓莉, 张怀武, 苏桦, 钟智勇

电子科技大学微电子与固体电子学院, 成都 610054

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摘要 半金属材料Fe_3O_4是一种新型的功能自旋电子材料, 由于其具有百分之百的自旋极化率而备受关注. 但由于铁元素存在多种价态的氧化物, 使得制备单一成分的Fe_3O_4非常困难, 因而本文着重对磁控反应溅射制备单一成分的Fe_3O_4薄膜进行了研究, 探索了晶化温度对薄膜结构的影响, 并通过引入缓冲层Ta对其性能进行改善, 得到了反应溅射制备半金属Fe_3O_4的最优条件. 另外, 通过对所制备的Fe_3O_4薄膜磁电阻效应的测试, 发现多晶Fe_3O_4具有同单晶Fe_3O_4薄膜类似的负磁电阻效应, 因此有望将其应用到自旋电子器件中.

关键词 半金属材料 自旋电子材料 Fe3O4薄膜

分类号 0482

Preparation of Half-metallic Fe_3O_4 Films

TANG Xiao-Li, ZHANG Huai-Wu, SU Hua, ZHONG Zhi-Yong

Institute of Micro-electronics and Solid-state Electronics, University of Electronic Science and Technology of China, Chengdu 610054, China

Abstract Half-metallic magnetic material Fe_3O_4 is a new kind of spintronics material, which can provide 100% spin polarization. The Fe element has many electronic valences, so the pure Fe_3O_4 is difficult to prepare. Therefore, in this paper we mainly focused on finding the optimal way to fabricate pure Fe_3O_4 film. Half-metallic Fe_3O_4 films grown on Si (100) substrates were prepared by DC magnetron reactive sputtering. The annealing temperatures were investigated carefully, and the polycrystalline Fe_3O_4 films fabricated on Ta buffer layer shown better properties than the film directly sputtering on Si substrate. The optimum condition for the formation of polycrystalline Fe_3O_4 under DC magnetron reactive sputtering was found. The negative magnetoresistance of polycrystalline Fe_3O_4 was also tested, and showed a very weak saturation trend as the single-crystalline Fe_3O_4 films.

Key words half-metallic material spintronic material Fe3O4 thin film

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通讯作者 唐晓莉 tangtang1227@163.com