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Pr, Mn多元渗对 $BaTiO_3$陶瓷结构与电性能的影响

郝素娥, 黄金祥, 张巨生, 王进福, 刘志刚

(哈尔滨工业大学应用化学系, 哈尔滨 150001)

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摘要 采用溶胶-凝胶法制备了纯$BaTiO_3$、Pr, Mn液相掺杂及气相多元扩渗改性的$BaTiO_3$陶瓷. 研究结果表明, Pr掺杂能使纯BaTiO3陶瓷的室温电阻率下降为$1.01\times10^5\Omega\cdot m$; 而Mn掺杂使室温电阻率升高为$1.50\times10^{13}\Omega\cdot m$. 但Pr和Mn的气相扩渗都能降低$BaTiO_3$陶瓷的室温电阻率至$1.08\times10^3\Omega\cdot m$和$1.29\times10^5\Omega\cdot m$. Pr-Mn共渗BaTiO3陶瓷出现了典型的NTC效应. XRD分析表明, Pr或Mn掺杂并不能改变BaTiO3陶瓷的物相结构, 但经Pr-Mn共渗后, 出现了新化合物$BaMn_{0.12}Al_{1.88}O_4$和Al_8Mn_4Pr的特征峰. XPS分析表明, 气相多元渗使Pr, Mn, C元素都扩渗到陶瓷体内, 并使各化学元素之间的结合更加牢固. SEM测试结果表明, Pr, Mn气相扩渗使陶瓷表面明显改观, 晶粒生长完整, 粒度分布均匀, 气孔率下降.

关键词 钛酸钡 稀土 气相扩渗 NTC效应

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Effect of Gaseous Penetration of Pr, Mn into $BaTiO_3$ Ceramics on Structure and Electrical Properties

HAO Su-E, HUANG Jin-Xiang, ZHANG Ju-Sheng, WANG Jin-Fu, LIU Zhi-Gang

(Department of Applied Chemistry, Harbin Institute of Technology, Harbin 150001, China)

Abstract Pure $BaTiO_3$ ceramics and Pr, Mn-doped $BaTiO_3$ ceramics were prepared by a sol-gel method. The pure $BaTiO_3$ ceramics were modified by the penetration of Pr and Mn in gaseous state, their structure and electrical properties were studied. The results show that the resisitivity of Pr-doped $BaTiO_3$ ceramics is decreased to $1.01\times10^5\Omega\cdot m$, the resisitivity of Mn-doped $BaTiO_3$ ceramics is increased to $1.50\times10^{13}\Omega\cdot m$, while both Pr and Mn penetration can decrease the resisitivity of $BaTiO_3$ ceramics evidently, which is $1.08\times10^3\Omega\cdot m$ and $1.29\times10^5\Omega\cdot m$, respectively . The Pr-Mn penetrated $BaTiO_3$ ceramics show a distinct NTC effect. The XRD results show that the perovskite structure of Pr or Mn doped $BaTiO_3$ ceramics does not change obviously, but there are new peaks of $BaMn_{0.12}Al_{1.88}O_4$ and Al_8Mn_4Pr in Pr-Mn penetrated $BaTiO_3$ ceramics. The XPS results show that Pr, Mn and C element are penetrated into $BaTiO_3$ ceramics, leading to the binding energy of modified $BaTiO_3$ ceramics increase and their stability improve. The SEM results show that Pr and Mn penetration can improve the surface state of BaTiO3 ceramics, the grains become finer and grow more integrally than pure $BaTiO_3$ ceramics, the porosity are decreased visibly.

Key words $BaTiO_3$ rare earth gaseous penetration NTC effect

DOI:

通讯作者 郝素娥 haosue@hit.edu.cn

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