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# PZT/Ag功能复合材料的介电常数异常

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摘要 以PZT和纯Ag粉末为原料, 在1200℃下用普通粉末烧结工艺制备了PZT/Ag复合材料. 尽管烧结温度超过了Ag的熔点, Ag粉末并未氧化, 也未与PZT相中的Pb发生反应形成合金, 而是以单质Ag的形式弥散分布在PZT基体中, 并且PZT/Ag界面结合良好, 同时发现有微量的Ag替代Pb进入了PZT的晶格位置. 在0<15vol% Ag成分范围内研究了PZT/Ag功能复合材料的介电性能, 发现其介电常数\varepsilon_r随Ag含量的变化表现为先降后升(临界成分点: 1vol% Ag)的趋势, 并不符合用于预测介电体中添加导电第二相引起介电常数增加的经典Maxwell方程. 在钙钛矿结构A位离子取代和渗流效应的理论基础上解释了上述介电常数的异常变化, 认为是由于在低成分范围内, $Ag^{+}$取代$Pb^{2+}$降低介电常数$\varepsilon_r$并起主导作用; 随着Ag含量的增加, Ag第二相颗粒之间建立的有效介电场增加了介电常数并逐渐起主导作用.

关键词 PZT/Ag 复合材料 介电常数

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# Dielectric Constant Anomaly in PZT/Ag Functional Composites

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**Abstract** The PZT/Ag composites were fabricated via conventional powder processing at 1200℃ by using PZT and Ag powders as the starting materials. Although the sintering temperature being higher than melting point of Ag, the pure Ag particles were homogeneously dispersed in the PZT matrix with sound PZT/Ag interfaces, and no metallic alloys between Ag and Pb were formed. At the same time, a small quantity of Ag was found to diffuse into the Pb-lattice. In the range of 0~15vol% Ag, the dielectric properties of the PZT/Ag composites were investigated. The results show that the relative dielectric constant $\varepsilon_r$ first decreases when Ag concentration is <1vol%, and then increases gradually up to 15vol%. This dielectric constant anomaly was explained on the basis of A-site cation substitution of perovskite structure as well as the percolation theory. In the lower Ag concentrations, the $Ag^{+}$ substitutes $Pb^{2+}$ and decreases the dielectric constant and this is the dominant mechanism; with the increase in Ag concentration, the effective dielectric field is established to increase the dielectric constant and it gradually becomes the dominant mechanism.

**Key words** PZT/Ag composite dielectric constant

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