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$Cu_xAl_{10}O_2$ ($0.92 \leq x \leq 1.0$) 陶瓷电输运性能

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摘 要: 使用高温固相烧结法制备不同化学计量比的 $CuAlO_2$ 陶瓷, 研究 $Cu_xAl_{10}O_2$ ($0.92 \leq x \leq 1.0$) 中Cu、Al摩尔比的相对变化对其结构和导电性能的影响。结果表明: $Cu_xAl_{10}O_2$ ($0.92 \leq x \leq 1.0$) 陶瓷片的结构和密度随着x值的增大, 样品的结晶性逐渐变好, 密度也逐渐增大, 在x为0.98时, 得到密度最大(5.02 g/cm^3)且结晶良好的纯相 $CuAlO_2$; 样品的光学带隙均约为3.44 eV; 随着x值的增加, 室温电导率先增大然后减小, 在x为0.98时得到最大电导率为 $8.03 \times 10^{-3} \text{ S/cm}$; 电导率随温度的升高而显著增大, 且曲线在100~300 K之间很好地符合Arrhenius关系, x为0.98时激活能最低, 仅为0.085 eV; 在所研究的成分范围内, $CuAlO_2$ 陶瓷的导电能力主要取决于陶瓷片的致密度。

关键字: $CuAlO_2$ 陶瓷; 铜铁矿结构; 致密度; 电导率; 热激活能

Electrical transport properties of Cu_xAlO_2 ceramics

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Abstract: The nonstoichiometric Cu_xAlO_2 ceramics were successfully prepared by solid state sintering at high temperature. The effects of the x value on the band gap and electrical conductivity were investigated. The results show that the structure and density of Cu_xAlO_2 ceramic plates show a notable improvement with the increasing content of Cu. The maximum value of density is 5.02 g/cm^3 for Cu_xAlO_2 ceramic with $x=0.98$ and the XRD pattern indicates that it is a pure $CuAlO_2$ phase. The optical band gap of Cu_xAlO_2 ceramics is about 3.44 eV. The conductivity at room temperature increases first and then reduces with the increasing content of Cu. The maximum conductivity is about $8.03 \times 10^{-3} \text{ S/cm}$ with $x=0.98$. The temperature dependence of electrical conductivity agrees well with the Arrhenius relationship, indicating that the electrical conducting is ascribed to thermal activation in the range of 100–300 K. The minimal value of the activation energy is estimated 0.085 eV. The electrical conductivity of Cu_xAlO_2 ceramics mainly depends on the density of the samples in the investigating range.

Key words: CuAlO₂ ceramics; delafossite; density; electrical conductivity; activation energy

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