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研究论文

Cr³⁺离子掺杂对Al₂O₃粉末结构及发光性能影响

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摘要: 采用球磨法制备了不同浓度Cr₂O₃掺杂的Al₂O₃粉体,并在700℃、1200℃空气中退火2 h。1200℃退火后样品,除掺杂浓度为1.6%的样品中出现少量γ-Al₂O₃相外,其余样品相均为纯α-Al₂O₃。样品晶格常数随着Cr³⁺离子浓度的增加而增加。采用波长为579 nm的激发光源对样品进行荧光光谱检测发现所有样品在469--492 nm波段,均出现F⁺心所引起的缺陷发光峰。1200℃退火的所有样品都出现一个由Cr³⁺离子中电子由2A能级到4A₂能级跃迁引起的在694 nm的强烈发光带,掺杂浓度为0.3%时发光强度最高。当掺杂浓度高于0.3%时,样品中Cr³⁺未能完全替代Al₂O₃中的Al³⁺离子,出现耦合,产生浓度猝灭现象,导致该波长发光强度减弱。对比而言,700℃退火样品仅掺杂浓度为0.3%时出现694 nm的发光,且强度较低。

关键词: 无机非金属材料 Cr³⁺:Al₂O₃ 荧光 纳米粉体 球磨

Effect of Cr³⁺ Doping on Structure and Photoluminescence of Al₂O₃ Powders

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Abstract: Cr³⁺:Al₂O₃ nano-powders were prepared by ball milling method and annealed at 700℃ or 1200℃ for 2 h in the air. The samples annealed at 1200℃ are of single phase with the α-Al₂O₃ structure, except that there are some low-intensity peaks of γ-Al₂O₃ appearing in the Cr(1.6%) - doped sample. The samples' lattice constants increase with the increase of the doping of Cr³⁺ ions. Using the excitation source with a wavelength of 579 nm, the photoluminescence (PL) spectra of all the samples shows a strong emission band between 469 nm and 492 nm, which is ascribed to the absorption of F⁺ color center. The samples annealed at 1200℃ show a strong emission band at 694 nm caused by the transition of Cr³⁺ ions' electronics from 2A to 4A₂ and the 0.3% Cr doped sample shows the greatest fluorescence emission intensity. When the doped concentration was greater than 0.3%, too many Cr³⁺ ions can couple and lead to concentration quenching. In contrast, for the samples annealed at 700 !, only the 0.3% Cr doped sample exhibits a low - intensity emission peak at 694 nm.

Keywords: inorganic non-metallic materials Cr³⁺:Al₂O₃ fluorescence nano - powder ball milling

收稿日期 2011-07-04 修回日期 2011-07-25 网络版发布日期 2011-10-25

DOI:

基金项目:

沈阳理工大学博士启动专项基金2008(20)资助项目。

通讯作者: 高印博

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