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论文

超声喷雾共沉淀法制备的$Lu_3Al_5O_{12}$：Eu^{3+}纳米粉体发光特性

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摘要:

采用新型超声喷雾共沉淀法技术,以Lu_2O_3、Eu_2O_3、$Al(NO_3)_3 \cdot 9H_2O$为原料,制备了不同浓度Eu^{3+}离子掺杂的$Lu_3Al_5O_{12}$纳米粉体.用X射线粉末衍射表征了获得纳米粉体的相,用扫描电镜观察了纳米粒子的形貌.测定了粉体的激发光谱、$^7F_0$-$^5D_2$声子边带谱与发射光谱.研究了不同高温烧结温度与Eu^{3+}掺杂浓度对纳米粒子的发光强度与粒子形貌的影响规律.研究表明,当烧结温度高于900 ℃时,粉体发光强度明显增强,并且随着煅烧温度的增加,发光强度有所增强.Eu^{3+}离子的最佳掺杂浓度为5~7 mol%.根据稀土离子Eu^{3+}光学跃起矩阵元的特点,从发射光谱获得Eu^{3+}光学跃起的J-O参量Ω_2与Ω_4.在Eu^{3+}掺杂浓度均为5 mol%时,其强度参量达最小,电-声子耦合最强.然后随着掺杂浓度的进一步提高,强度参量略有增加,电-声子耦合减弱.说明Eu-O键强增加,共价性增强,Eu^{3+}的局域环境对称性降低.Ω_2值低于Eu^{3+}在玻璃与晶体基质中的情况,这是由于纳米粒子中存在着大量的缺陷以及晶体的结构畸变导致纳米粒子的对称性下降所致.

关键词: LuAG 纳米粉体 发射光谱 Eu^{3+} 光学强度参量

Emission Properties of Eu-doped Nano-$Lu_3Al_5O_{12}$ Powders by Ultrasonic Atomization and Co-precipitation Method

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Abstract:

Eu^{3+} doped nano-$Lu_3Al_5O_{12}$ powders were prepared by ultrasonic atomization and co-precipitation method with Lu_2O_3, Eu_2O_3 and $Al(NO_3)_3 \cdot 9H_2O$ as raw materials, and the obtained powders were sintered at various temperature. X-ray diffraction and scanning electron microscopy were employed to characterize the particle size and phase composition of the nano-powder. The emission, excitation and phonon-side band spectra of Eu^{3+}：$Lu_3Al_5O_{12}$ were measured. The result indicated when the sintering temperature was higher than 900℃, the luminous intensity was significantly enhanced and the optimum doping concentration of Eu^{3+} was 5~7 mol%. The Ω_2 and Ω_4 parameters of Eu^{3+} for optical transition were calculated from their emission spectra in terms of reduced matrix $U^{(t)}$ (λ=2,4,6) character for optical transitions. The results indicated that the intensity parameters Ω_2 reached to minimum and electron-phonon coupling to the maximum when the doping concentration of Eu^{3+} was ~5 mol%. With the increase of Eu^{3+} content, the optical parameter increased slightly and the electron-phonon coupling became weaker. It suggests that the symmetry becomes weaker, the bands of Eu and O atoms become higher and the covalence of Eu and O atoms increases. The Ω_2 of the powder shows an obvious lower value by comparing with those of Eu^{3+} in glass and crystal matrix, which is result from the symmetrical decreasing of the nanoparticles induced by a large number of defects and structural aberrations.

Keywords: $Lu_3Al_5O_{12}$ Nano-powder Emission spectra Eu^{3+} ion Optical intensity parameter

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