

论文

离子交换法制备 $ZrO_2:Eu^{3+}$ 纳米晶及其发光特性

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摘要:

以强碱性阴离子交换树脂为沉淀剂, 采用离子交换法制备了 $ZrO_2:Eu^{3+}$ 纳米晶. 通过XRD, TEM, HRTEM和EDS等对晶体的结构、形貌及化学成分进行了表征, 利用3D荧光光谱、激发光谱和发射光谱研究了 Eu^{3+} 在 ZrO_2 纳米晶中的发光性质. 结果表明, 焙烧温度在800℃以下所得的 $ZrO_2:Eu^{3+}$ 纳米晶主要为四方结构, 晶粒尺寸约为5-20 nm, 随着焙烧温度的升高, 样品的晶结构发生了细微变化, 从900℃开始出现了少量单斜晶. 由 $ZrO_2:Eu^{3+}$ 的3D荧光光谱确定了其最佳监测波长和发射波长, 在394 nm波长光的激发下观察到纳米 ZrO_2 中 Eu^{3+} 的590 nm ($^5D_0 \rightarrow ^7F_1$) 和606 nm ($^5D_0 \rightarrow ^7F_2$) 特征发射谱, 随着相结构细微的变化, 发射光谱的形状及强度均发生变化, 说明 $ZrO_2:Eu^{3+}$ 纳米晶的发光性质对其结构非常敏感.

关键词: $ZrO_2:Eu^{3+}$ 纳米晶 离子交换法 发光性质

$ZrO_2:Eu^{3+}$ NANOCRYSTAL FABRICATION AND ITS LUMINESCENCE PROPERTIES BY ION EXCHANGE METHOD

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Abstract:

Eu^{3+} doped luminescent nano-materials have become a research focus due to their outstanding physical and chemical properties in light-emitting, magnetism, thermology, catalysis and chemical activity etc.. Furthermore, the relationship between crystal structure and energy levels transition of these nano-materials can be easily obtained by measuring the spectra of doped Eu^{3+} . Among luminescence nano-materials, ZrO_2 nano-crystal as a potential one has been attracted great attention in its higher refractive, good optical transparency and relatively low phonon energy. By now certain materials doped RE ion in the matrix ZrO_2 for $ZrO_2:Er^{3+}-Y^{3+}$, $ZrO_2:Pr^{3+}$ and $ZrO_2:(Pr^{3+}, Sm^{3+})$ etc., and mesoporous ZrO_2 nano-crystals doped Eu^{3+} by hydrothermal way have been reported. In present study, the $ZrO_2:Eu^{3+}$ nano-crystal was prepared with high purity and uniform composition by ion exchange method using strong OH^- as a precipitant. Its composition, morphology and structure were characterized by XRD, TEM, HRTEM and EDS. The experimental results show that it has a tetragonal crystal structure and its average grain size is 5—20 nm after calcined at 800 °C. It is found that the microstructure of $ZrO_2:Eu^{3+}$ changes slightly with the increase of calcining temperature till a small amount of monoclinic phase forms after calcined at higher than 900 °C. The luminescent properteof Eu^{3+} in the ZrO_2 nano-crystal were measured by 3D emission and excitation spectra. The characteristic emissin bands of 590 nm ($^5D_0 \rightarrow ^7F_1$) and 606 nm ($^5D_0 \rightarrow ^7F_2$) of Eu^{3+} were observed at an excitation spectrum of $\lambda_{ex}=394$ nm. The luminescent properties of $ZrO_2:Eu^{3+}$ are very sensitive to its microstructure change since slight changes in the $ZrO_2:Eu^{3+}$ microstructure cause the changes in the shape and intensity of its emission spectra.

Keywords: $ZrO_2:Eu^{3+}$ aocrystal ion exchange method luminescence property

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