摘 要

在本研究中，主要在探討氧化鋅、鋁酸鋅和鹵磷酸鹽的奈米螢光體化學反應合成與物性及光學性質。首先對在氧化鋅生成反應，發現在Zn0/Si基板上，在75 °C時，可合成沿c軸方向高密度的氧化鋅奈米棒。且使用氮氣氛去作熱處理，可以提升氧化鋅奈米棒在紫外光的強度。經由EXAFS量測之後，發現到氣氛可能只是被吸附或者是陷入在氧化鋅奈米棒的表面。

而在奈米級鋁酸鋅粉體的生成，發現到pH值和反應的溫度，在合成奈米尺寸鋁酸鋅上扮演一個很重要的角色。在pH=7，150°C時，可以透過中間產物(ZnAl-LDH)的生成，進而合成平均顆粒大小在 5 nm 範圍的鋁酸鋅奈米體。當奈米體表面經過表面活性劑CTAB處理之後，則可以形成$ZnAl_2O_4$/Eu核殼結構。

進一步探討合成奈米級的銪摻雜鹵磷酸鹽。發現在室溫下pH=2 時，可以同時生成含有Cl和OH兩種不同的鹵磷酸鹽相。但是當pH值超過 7 時，只有含有OH的鹵磷酸鹽相會被生成。當在經過 850°C還原氣氛熱處理之後，在不同pH值下，粉體會成呈現不同的藍色和紅色放射光強度。這些結果暗示了，紅光和藍光兩者之間相對的放射強度，可以藉由控制pH值(結晶相)和改變熱處理的氣氛來調控。

ABSTRACT

In this thesis, most of my researches were primarily focused on the synthesis and optical characterization of ZnO-based nanosized phosphors. Firstly, as the ZnO films were pre-treated with nitrogen implantation in the range from $5x10^{12}$ to $5x10^{15}$ ions/cm^2, it was found that the peak intensity of near band-edge emission remarkably decreases with the increase of concentration of implanted nitrogen when annealed in nitrogen atmosphere. However, as the ZnO was implanted with $5x10^{12}$ ions/cm^2 and annealed in oxygen atmosphere, the optical properties are improved probably.

Subsequently, high-density ZnO nanorods can be vertically grown on Si coated with ZnO film (ZnO/Si substrate) from aqueous solution at 75^{o}C. It was observed that enhancement of PL properties due to N_2-atmosphere annealing for ultraviolet emission was obtained and can be attributed to the reduction of defect density. The extended x-ray absorption fine structure (EXAFS) reveals that most ions are possibly trapped or adsorbed on the surface of the ZnO nanorods and thus, the annealing atmosphere shows no apparent influence on the deep-level defects of ZnO nanorods.

In addition, europium doped nanocrystalline zinc aluminate ($ZnAl_2O_4$) particles were prepared by hydrolyzing a mixture of aluminum chloride hexahydrate and zinc chloride in deionized water. At pH=7 and T>120^{o}C, the nanocrystalline $ZnAl_2O_4$ particles with average particle size of ~5 nm are easily synthesized through ZnAl layered double hydroxide (ZnAl-LDH). After surface treatment with the cationic surfactant CTAB, the $ZnAl_2O_4$/Eu core-shell structure may be developed. The $ZnAl_2O_4$/Eu core-shell structure can show both emissions from $^5D_0$ to $^7F_2$ sensitivity energy level and $^5D_2$ to $^7F_0$ depth energy level.

Finally, the synthesis and optical properties of nanocrystalline Eu-doped

halo-phosphate powders, $Ca_5(PO_4)_3(OH):Eu^{3+}$, were also investigated. At pH=2, both $Ca_{8.3}Sr_{1.7}(PO_4)_6Cl_2$ and $Ca_{8.3}Sr_{1.7}(PO_4)_6(OH)_2$ phases were detected, but for the solution with pH value over 7, only one $Ca_{8.3}Sr_{1.7}(PO_4)_6(OH)_2$ phase was identified. After annealed at 850^oC in a reduction atmosphere, different relative ratio of blue and red emissions can be controlled through changing the various pH-solutions. These results indicate that the relative peak intensity of both red and blue emissions can be tunable by controlling the solution pH value (crystalline phase) and changing annealing atmosphere.

This thesis is dedicated to my family.

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