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MICROWAVE ASSISTED SYNTHESIS AND CHARACTERIZATION OF $ZrO_2:Eu^{3+}$ NANOPHOSPHORS AND STUDY OF PHOTOLUMINESCENCE PROPERTY

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FINAL PROGRESS REPORT

Ref: 1362-MRP/14-15/KABA007/UGC-SWRO

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EXECUTIVE SUMMARY

It is well known that phosphors are essential materials for the development of high resolution optical display systems, imaging devices and lamps. Rare earth (RE) ions activated phosphors, have found to be excellent luminescent materials because of their marked improvements in lumen output and color rendering index. Nanophosphors are inorganic nanoparticles with luminescent properties of interest for radiation detection and optoelectronic applications, including lighting and imaging. The interest in this class of materials stems mainly from the possibility of achieving unique properties related to the reduced dimensionality and spatial confinement of the energy states, as is seen in nanoscale materials, and the possibility of synthesis at much lower temperatures when compared to traditional methods like solid state reaction and crystal growth.

Greater purity and homogeneity from novel methods can lead to improved physical, chemical, mechanical and thermal properties. The present trend is to avoid brute force methods in order to have a better control of stoichiometry, structure, and phase purity of materials. Soft chemical routes are now increasingly becoming important to prepare a variety of phosphor materials. These approaches make use of simple chemical reactions like sol–gel, ion exchange, hydrolysis, acid leaching, and so on, at considerably low temperatures compared to the solid state method. However, for industrial purpose large quantity of the product is required. In solid-state method, phase

purity and particle size control is not possible. Also, due to its high-temperature course it is not suitable for the preparation of nanocrystalline materials. However, the microwave method provides the faster route for the synthesis of the RE doped ceramic luminescent materials.

Rare earth ions (Eu) have been widely used as activators in zirconia host due to their high efficiency emission performance. Europium is a special element in the lanthanides besides the common properties of rare earth elements, it exhibits the property of valence fluctuation, i.e. the valence state is divalent or trivalent, and it has different luminescence characteristics due to the different valences. The electronic configuration of Eu^{3+} ion is $4f^6$; the emission spectrum of Eu^{3+} shows emission lines extending from visible to the near infrared. Being an important emitter in the red region of the visible spectrum, Eu^{3+} ions have been utilized extensively in electroluminescence panels (EL), plasma display panels (PDP), higher efficiency fluorescent lamps, etc.

The effect of RE3+ ions on luminescence characteristics of ZrO_2: Eu^{+3} was studied and the results were discussed in detail. The Europium doped phosphor exhibit bright red emission upon 250 nm excitation. The characteristic photoluminescence emission peaks at ~591, 597, 613, 626 and 655nm and $^5D_0 \rightarrow {}^7F_j$(j=0,1,2,3,4) were recorded due to Eu^{3+} ions. The electronic transition corresponding to $^5D_0 \rightarrow {}^7F_2$ of Eu^{3+}ions (613 nm) was stronger than the magnetic dipole transition corresponding to $^5D_0 \rightarrow {}^7F_1$ of Eu^{3+}ions (597 nm). Further, the excellent emission properties and the estimated CIE chromaticity co-ordinates

of RE^{3+} doped ZrO_2 are very close to NTSC standard values of this phosphor. Hence, the ZrO_2:Eu^{3+} nanophosphors are promising materials in optical display system applications.

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