



Near Infrared Long Persistent Nanophosphors for Bio Imaging Applications

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Long persistent phosphorescence is a phenomenon in which luminescence can last for few minutes to several hours after the removal of the excitation source¹. The materials which exhibit this phenomenon are known as long persistent phosphors. When these materials are excited by UV or Visible light, free electrons and holes are produced which can be captured by the various traps present in the materials. When the room temperature energy is close to the energy difference between the trapping level and host bands, these charges are detrapped and recombine with the ions and prolong the emission in visible or NIR region. Because of this unique property these materials find potential applications in versatile fields such as security application, safety signage, night vision materials, ratiometric thermometry, storage media, in vivo bio imaging². NIR region (650-1100 nm) is considered as biological optical window as in this range biological tissues become most transparent. Therefore the materials exhibiting emission in this region can be used as a probe for in vivo small animal optical imaging. The autofluorescence from the living tissues is prevented as the materials are excited externally before injecting into the animal body which improves the signal to noise ratio. For bioimaging application the materials must also be nanocrystalline and biocompatible.

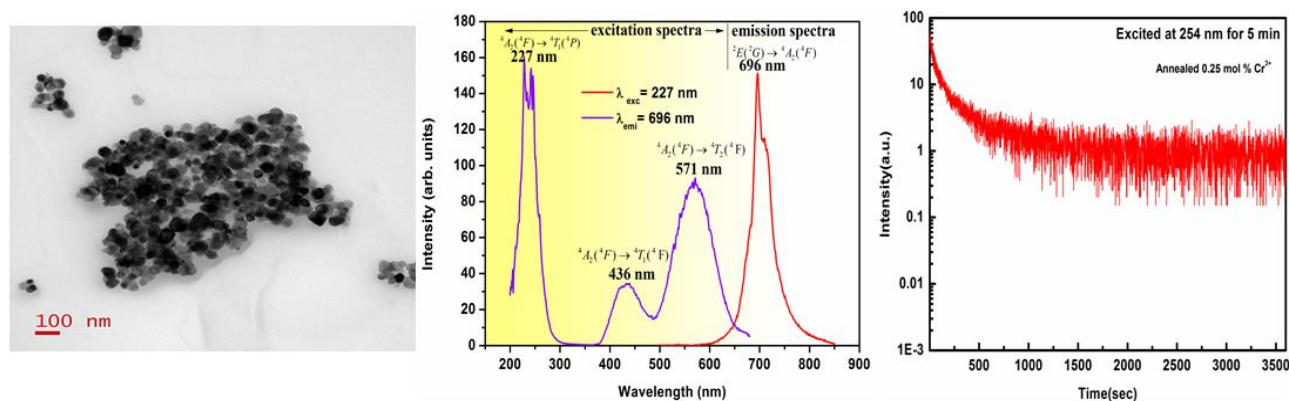


Figure 1: TEM image, PL spectra and afterglow decay curve of $\text{ZnGa}_2\text{O}_4:\text{Cr}^{3+}$ phosphor

In this context, we have shown the Cr^{3+} doped MgGa_2O_4 ($\text{M}=\text{Mg}, \text{Zn}$) nanophosphors with the NIR long persistent phosphorescence properties. The materials were prepared by hydrothermal and CTAB assisted hydrothermal reaction method respectively. As the ionic radius of Cr and Ga are nearly equal therefore Cr^{3+} ion substitutes the Ga^{3+} ions. The successful doping of Cr^{3+} ion and single cubic phase formation were confirmed from XRD pattern. The HRTEM micrographs confirmed the formation of nanoparticles (10-70 nm). The PL excitation spectra showed ${}^4\text{A}_2({}^4\text{F}) \rightarrow {}^4\text{T}_1({}^4\text{P})$, ${}^4\text{A}_2({}^4\text{F}) \rightarrow {}^4\text{T}_1({}^4\text{F})$, ${}^4\text{A}_2({}^4\text{F}) \rightarrow {}^4\text{T}_2({}^4\text{F})$ d-d transitions of Cr^{3+} at 225 nm, 442 nm and 558 nm for MgGa_2O_4 host and at 227 nm, 436 nm and 571 nm for ZnGa_2O_4 host. A broad PL emission spectra ranging from 600-800 nm due to ${}^4\text{T}_2({}^4\text{F}) \rightarrow {}^4\text{A}_2({}^4\text{F})$ spin allowed transition of Cr^{3+} with a sharp peak corresponding to ${}^2\text{E}({}^2\text{G}) \rightarrow {}^4\text{A}_2({}^4\text{F})$ spin forbidden transition of Cr^{3+} ion were observed at 707 nm and 696 nm for MgGa_2O_4 and ZnGa_2O_4 host respectively. The afterglow decay of the LLP phosphors were measured after exciting them at 254 nm UV light for 15 minutes externally. Significant LLP signal was being observed for 1 hour. Small particle size and long persistent phosphorescence in NIR region confirms the suitability of the materials to be used as probes in bio imaging.

Bibliography :

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