CONCLUSIONS AND FUTURE PROSPECTS

The photon upconversion emission properties of Er^{3+} and Yb^{3+} co-doped have been studied in $Y_2Ti_2O_7$ hosts. Yb^{3+} ion is used as a codopant to enhance the upconversion emission of Er^{3+}ions. The Yb^{3+} ion has very strong absorption at 976 nm with high energy transfer efficiency to these emitting ions. The lasers around 976 nm are cost effective and portable so this is addition advantage of using this excitation. For sample preparation solid state ceramic route and auto combustion methods are used.

Eu^{3+} has generally been selected as the activator ion to investigate the luminescence properties of rare earth doped tungstate/molybdate materials as it shows brilliant emission in the visible region near UV excitation. Since ground electronic state configuration of Eu^{3+}ion has $^7F_0$ non degenerate and having non-overlapping $^{2S+1}L_J$ multi-plets. Therefore Eu^{3+} ion can be used as a structural probe for investigating the local environment in a host matrix

The nanostructured materials have high electron phonon coupling and recent studies on rare earth doped nanomaterials have shown strange optical properties. In the study on Er^{3+}/Yb^{3+} doped $Y_2Ti_2O_7$ phosphors, highly intense upconversion emission was observed. The images were simply photographed by a Nikon Coolpix P 500 digital camera using suitable filter. Also colloidal solution of the Er^{3+}/Yb^{3+} doped $Y_2Ti_2O_7$ has been prepared by laser ablation method under 355 nm Nd-YAG laser excitation. A strong absorption band at 1.45 μm is observed in absorption spectrum of colloidal solution.

Further downshifting properties of Eu^{3+} activated $CaMoO_4$ host has been studied via Gd^{3+} co-doping under 266 Nd-YAG laser excitation. Structural and photo-physical properties have been studied in detail. Gd^{3+} codoping in $CaMoO_4$:Eu matrix induces distortions and high asymmetricity (A_{21}~10-16) which corroborate it as a red emitter. High Asymmetric value favours the transitions of higher order odd rank transitions as $4f^{n-1}5d$ to $4f^n$ and hence enhanced emission intensity was observed. Results show that improved emission intensity of Eu^{3+} ion via Gd^{3+} co-doping can be a potential red phosphor in lightning application.

Further upconversion and temperature sensing studies has been performed on Er^{3+}/Yb^{3+} co-doped $Y_2Ti_2O_7$ via incorporation of Li^+ ion. Emission intensity increases after incorporation of Li^+ ion in Er^{3+}/Yb^{3+} doped $Y_2Ti_2O_7$ matrix. Li^+ incorporation induces the defects and/or vacancies in the matrix and creates the asymmetric environment around the Er^{3+} ions. Temperature sensing performance of Li^+ incorporated Er^{3+}/Yb^{3+} co-doped $Y_2Ti_2O_7$ has been studied using fluorescence intensity ratio (FIR) technique.

Future plan:

As studied phosphors have shown very efficient upconversion emissions on optical excitation, the work would be continued on the studied systems. Specific efforts would be done to develop phosphors for latent finger print detection and optical based temperature sensing on $Y_2Ti_2O_7$ host. Also the colloidal solution of the RE doped $Y_2Ti_2O_7$ will be further prepared at different excitation powers and are studied for their toxicity in future study. Highly water dispersible RE ions doped $CaMoO_4$ host would be studied in more deep and uniform size and shape would be try to develop. It would increase its applicability in finger printing and bio-imaging.

Also effort would be executed in how to precisely control the number of functional molecules on the surface of nanoparticles. The use of fluoride nanoparticles in the photodynamic therapy (PDT) is still in its infancy and will be studied. Also *in vitro* and *in vivo* study of these fluoride nanoparticles would be studied in more detail in future study.

The application of luminescent materials as spectral converters to Photovoltaic (PV) applications could not come at a more opportune time given the significant increase in the global demand for energy in recent years. Despite the daunting challenges of realizing low-cost and highly efficient solar cells, further exploration to use these spectral converting materials using downconversion (quantum cutting), downshifting and upconversion properties for PV devices will be studied .

In order to further increase in up and downconversion efficiency, plasmonic enhancement process would be used. For this thin films of Silver/Gold metals with phosphor layer would be deposited on polymer base. The basic mechanism would be studied using steady state and time resolved fluorescence techniques. The time resolved fluorescence measurements would provide actual dynamics of enhancement.

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