Structure, Morphology and Luminescent Properties in Eu$^{3+}$ activated (Y,Gd)F$_3$ Nanophosphors

Sushri Sangita Nanda, Priyanka Nayak and S. Dash$^a$
Dept. of Physics and Astronomy, NIT Rourkela, Rourkela, Odisha-769008, India

$^a$Corresponding author: dsuryanarayan@gmail.com

ABSTRACT
A series of Nanophosphors is developed by doping Eu$^{3+}$ in (Y,Gd)F$_3$ (YF$_3$:5at%Gd, x at%Eu (0 ≤ x ≤ 10) using modified hydrothermal route. The XRD, FESEM, Raman and Luminescence (PL) spectra are systematically studied to investigate the effect of doping.

EXPERIMENTAL DETAILS
A series of nanocrystalline powders of YF$_3$: 5%Gd$^{3+}$, (Y, Gd)F$_3$: 3%, 5%, 7%, 10% Eu$^{3+}$ were synthesized by a modified hydrothermal synthesis route using high purity (>99.9%) raw powders of Y(NO$_3$)$_3$, Gd(NO$_3$)$_3$, NH$_4$F, Eu(NO$_3$)$_3$, 6H$_2$O.

1. Nitrate were stirred for 30 mins with Millipore water
2. NH$_4$HF$_2$ was added and stirred for one hour
3. Kept in autoclave at 130°C for 12 hours
4. Precipitated using Millipore water, ethanol and isolated by centrifuging at 8000rpm for 10 mins
5. Dried at 70°C for 4 hours and power sample was collected

The phase purity and structure is characterized through XRD (Rigaku, Japan) with Cu-Kα. The morphology was examined by FESEM NOVA NANOSEM450.

Photoluminescence was performed on a PerkinElmer (LS-55).

RESULTS AND DISCUSSIONS
X-Ray Diffraction
All the nanoparticles exhibited prominent peaks well accordant with JCPDS standard card No- 70-1935 of the orthorhombic YF$_3$ crystal with no secondary phase. It comprises eight fold orthorhombic structure where yttrium atom has eight fluoride ions placed at the distance 2.3 Å and one ion at 2.6 Å from it. All diffraction peaks shift toward larger lattice parameters with the increasing mole percent of Eu$^{3+}$.

PHOTOLUMINESCENCE
Room-T PLE and PL are recorded for various concentrations of Eu$^{3+}$ (Y,Gd)F$_3$ host matrices.

The excitation spectrum consisted may be due to the mixed characteristic absorption bands of two lanthanide couples Gd$^{3+}$-Eu$^{3+}$. Excitation maxima peaking at about 374 nm is monitored at 720 nm emission.

The relative intensity of the emission peak varies with the Eu$^{3+}$. This may be due to change in the local symmetry of the dopant ion or from the coupling effect multiple energy levels associated with the lanthanide activators.

RAMAN SPECTROSCOPY
Figure shows Raman spectra for (Y, Gd)F$_3$: 3%, 5%, 7%, 10% Eu$^{3+}$ under 532 nm laser excitation. Strong Raman peaks indicate stronger interaction between the atoms, which arises some stretching and bending of the shorter metal-metal bond in anionic groups.

CONCLUSIONS
- A series of nanophosphors are developed using hydrothermal route. The XRD spectra shows single phase and stoichiometric, implies the activator ions is at Y site.
- FESEM image reveals a nearly spherical in shapes of the nanoparticles with average particle size varies from 60-90 nm.
- From the PL, the relative intensity of the emission peak varies with the Eu$^{3+}$.

REFERENCES