Energy transfer processes in $Ca_3Tb_2Si_3O_{12}:Eu^{3+}$

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OUTLINE

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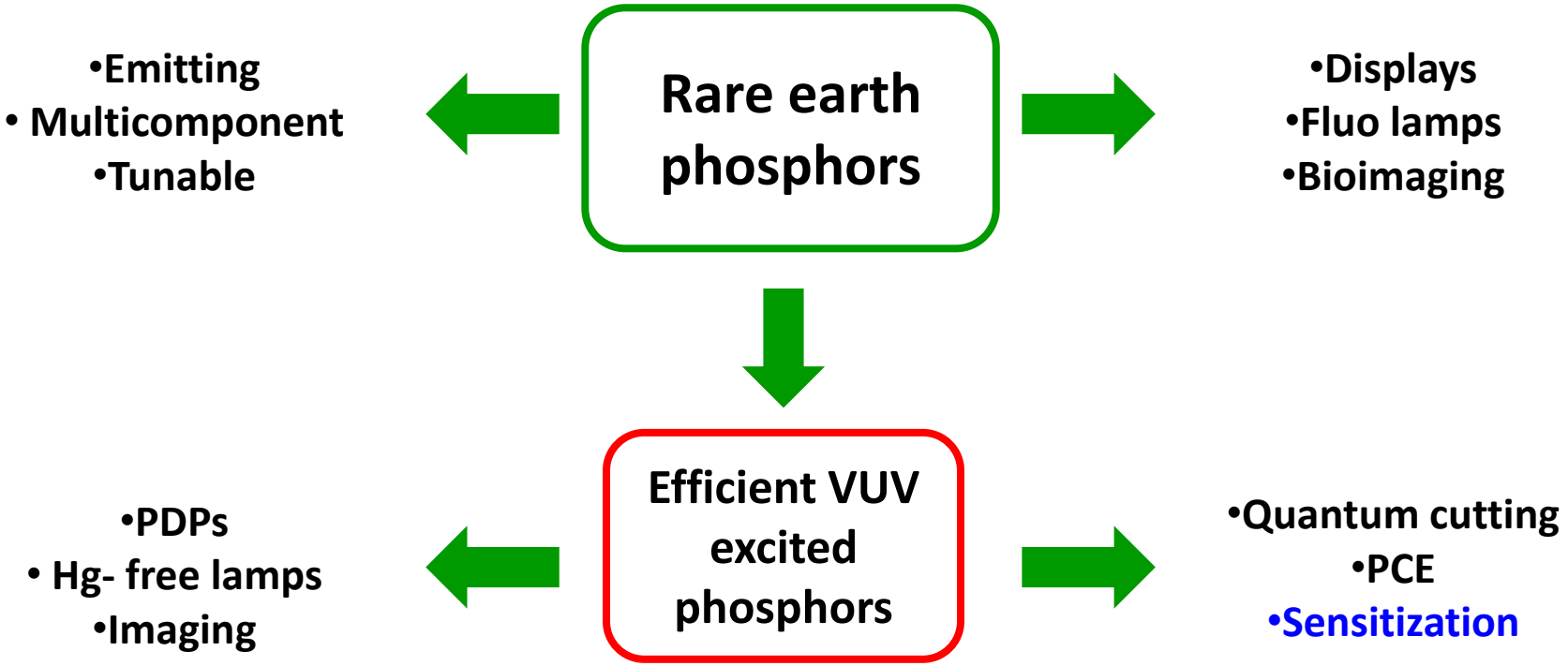
MOTIVATION



•Tb^{3+} good sensitizer for Eu^{3+} red emission by exploiting its strong *4f-5d* absorption bands located in VUV

•Green emission from Tb^{3+} and red emission from Eu^{3+} have many applications in lightling and displays

Silicate

→ Good transparency in UV/VIS

→ Chemical stability

→ Low cost

Silico-carnotite type structure

Good stability for RE doping from Eu-Lu ions

OBJECTIVE

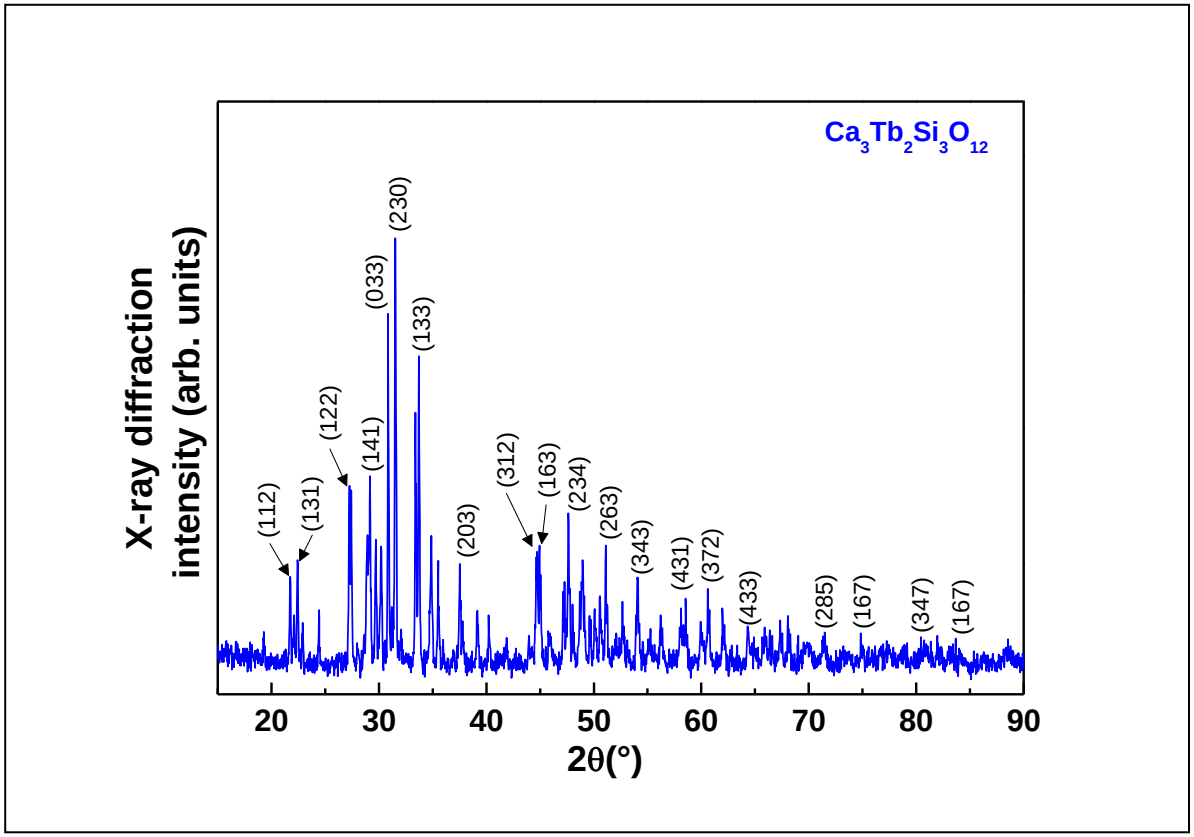
Study the Tb^{3+}-Eu^{3+} energy transfer processes in $Ca_3Tb_2Si_3O_{12}$:Eu^{3+} by performing luminescence and decay time experiments on both undoped and Eu^{3+} doped samples

SAMPLE DETAILS

$Ca_3Tb_2Si_3O_{12}$ and $Ca_3Tb_2Si_3O_{12}:Eu^{3+}$ (5 mol%)

Synthesized by SSR (III TT at 1450 ^oC x 3h)

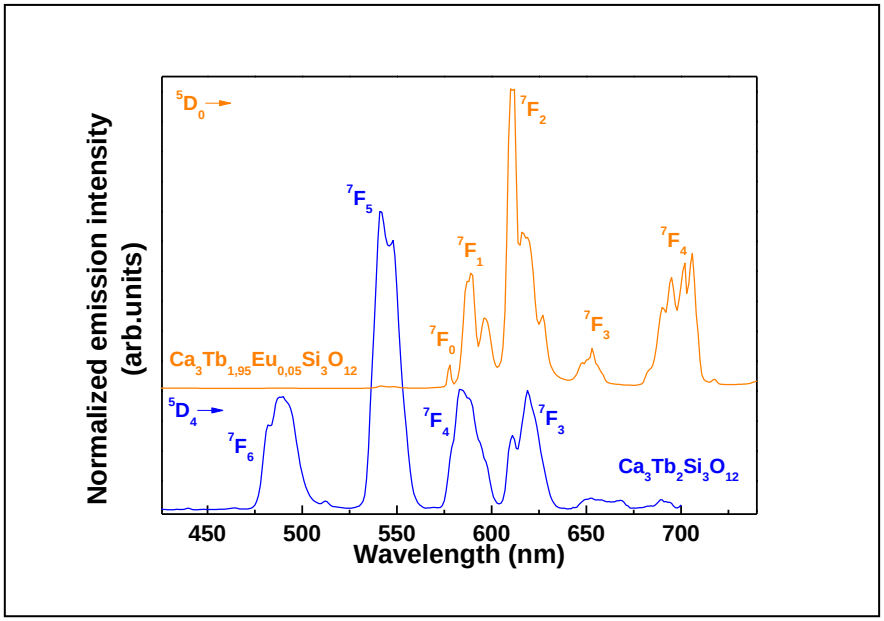
Pure phase

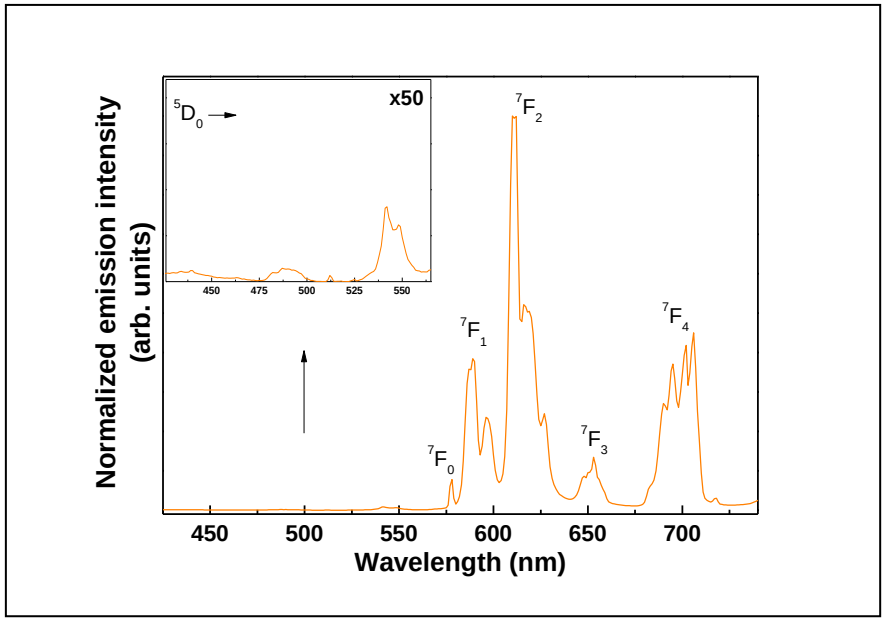


LUMINESCENCE RESULTS

RT EMISSION

λ_{exc} =377 nm $^5D_3$ (Tb^{3+})



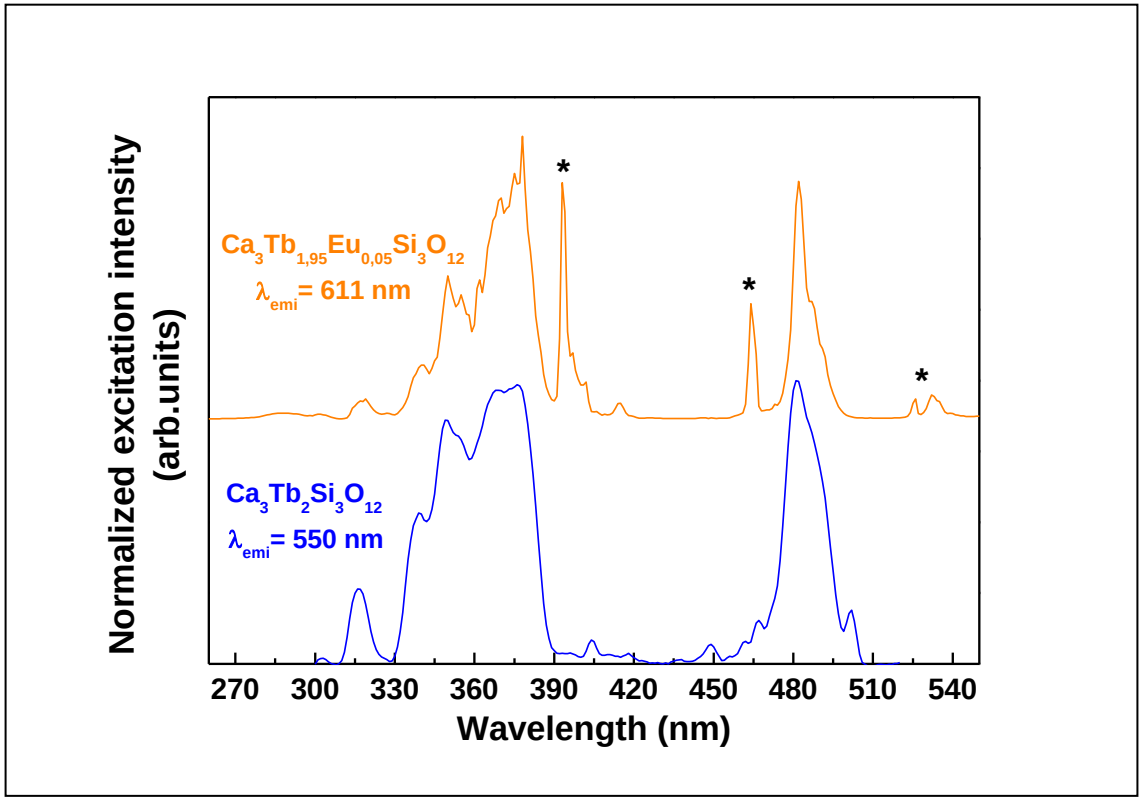


$$\frac{I_{^7F_2}(Eu^{3+})}{I_{^7F_5}(Tb^{3+})} = 123$$

Very efficient energy transfer from Tb^{3+} to Eu^{3+}

LUMINESCENCE RESULTS

RT EXCITATION



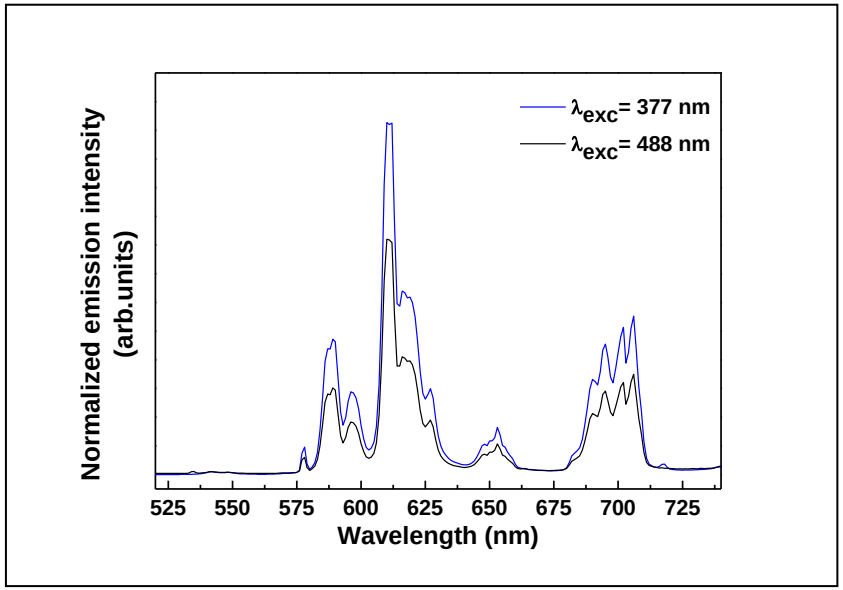
Only a few Eu^{3+} excitation bands are observed (labeled with *)

These results confirm the $Tb^{3+} \longrightarrow Eu^{3+}$ energy transfer

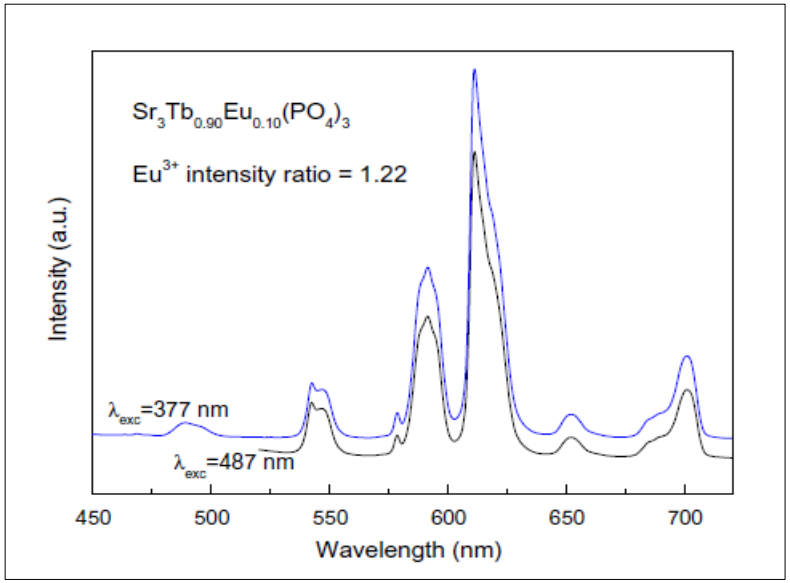
LUMINESCENCE RESULTS

RT EMISSION

Relative intensity of Eu^{3+} $^5D_0$ bands with respect to Tb^{3+} $^5D_4$ ones, depends on excitation pathway



Same behaviour observed in $Sr_3Tb(PO_4)_3$: Eu^{3+} (10%)



In the 570-720nm range:

$$\frac{I_{em}(\lambda_{exc} = 377nm)}{I_{em}(\lambda_{exc} = 488nm)} = 1.53$$

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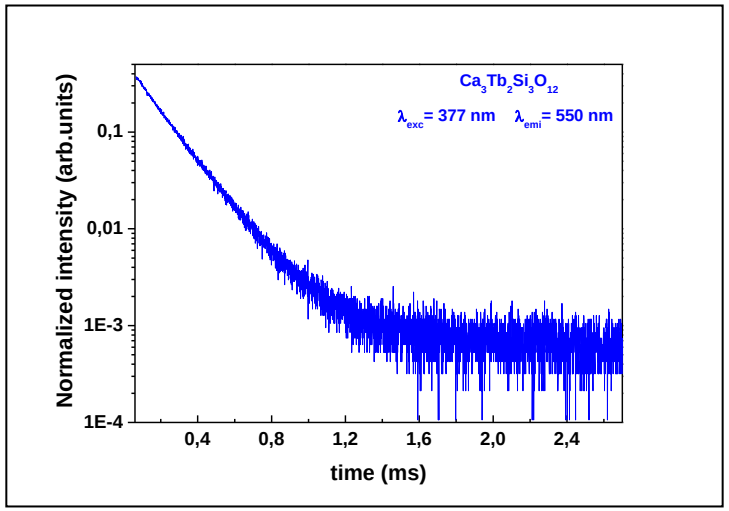
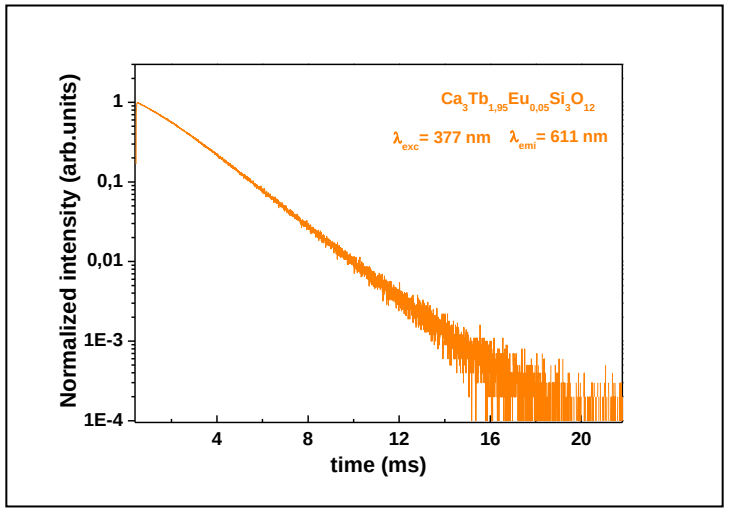
LUMINESCENCE RESULTS

RT DECAY CURVES





Exponential decay
Short time constant: τ= 166 μs

Non exponential decay
Time constant: τ (average) = 2.60 ms

No data for Tb^{3+} $^5D_4 \rightarrow {}^7F_5$ transition in $Ca_3Tb_2Si_3O_{12}:Eu^{3+}$ due to its very low intensity

For $Sr_3Tb(PO_4)_3$: Eu^{3+} (10%): $\eta_T = 1 - \frac{\tau_{Tb-Eu}}{\tau_{Tb}} = 0.93$

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Efficiency of the energy transfer $\eta_T > 0.93$

CONCLUSIONS

Clear evidences of energy transfer from Tb^{3+} to Eu^{3+}

Tb^{3+} emission almost quenched
$\longrightarrow$ very strong Eu^{3+} emission

Efficient changes in the emission colour of the material by the addition of 5 mol% Eu^{3+}

FUTURE WORK

Nanosized materials

Synthesis of materials with various Eu^{3+} doping concentration under 5 mol%

Study of diluted Tb^{3+} compounds

Thank you for your attention

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