


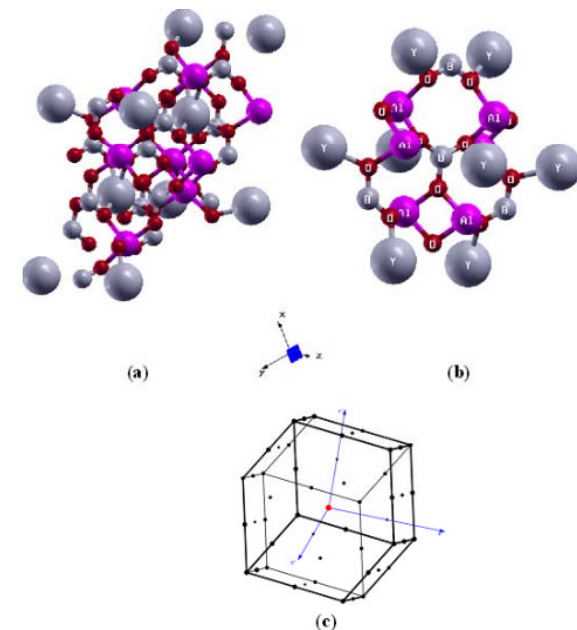
Preparation and Photoluminescence Properties of $\text{YAl}_3(\text{BO}_3)_4:\text{Tb}^{3+}$, Bi^{3+} Phosphor under VUV/UV Excitation



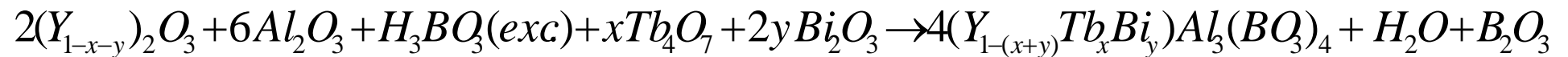
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- **Modern displays = PDPs**
- **Xe₂^{*} discharge lamp: 147 nm and 172 nm**
- **State-of-the-Art phosphors:**
 - BaMgAl₁₀O₁₇:Eu²⁺
 - YBO₃:Eu³⁺
 - Zn₂SiO₄:Mn²⁺
 - High chemical stability
 - High luminescence efficiency
 - High colour purity

But: unsatisfying decay time
- **Alternative YAl₃(BO₃)₄:Tb³⁺, Bi³⁺** 



- Solid state reaction



- **Procedure**

- Ball mill 10 h
- Firing at 500 ° C 2 h
- Subsequent firing at different steps between 900-1250 ° C for 5 h

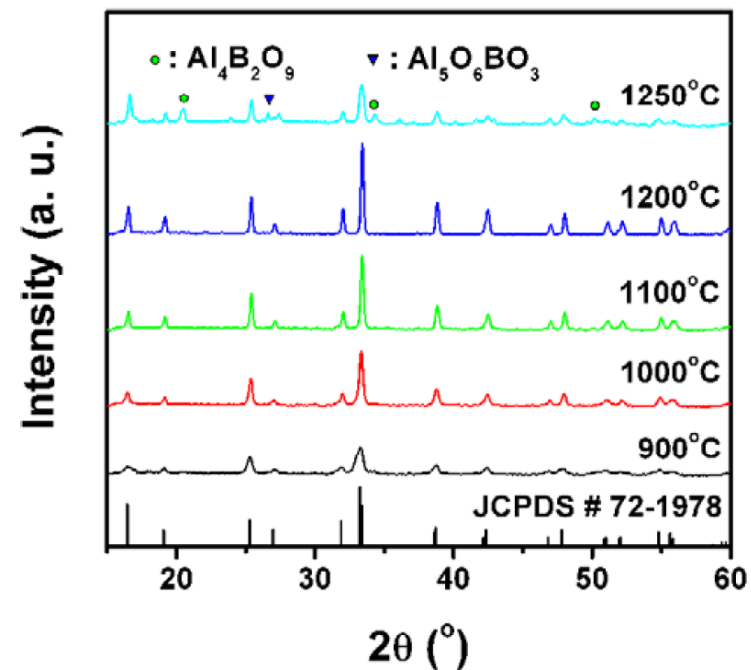
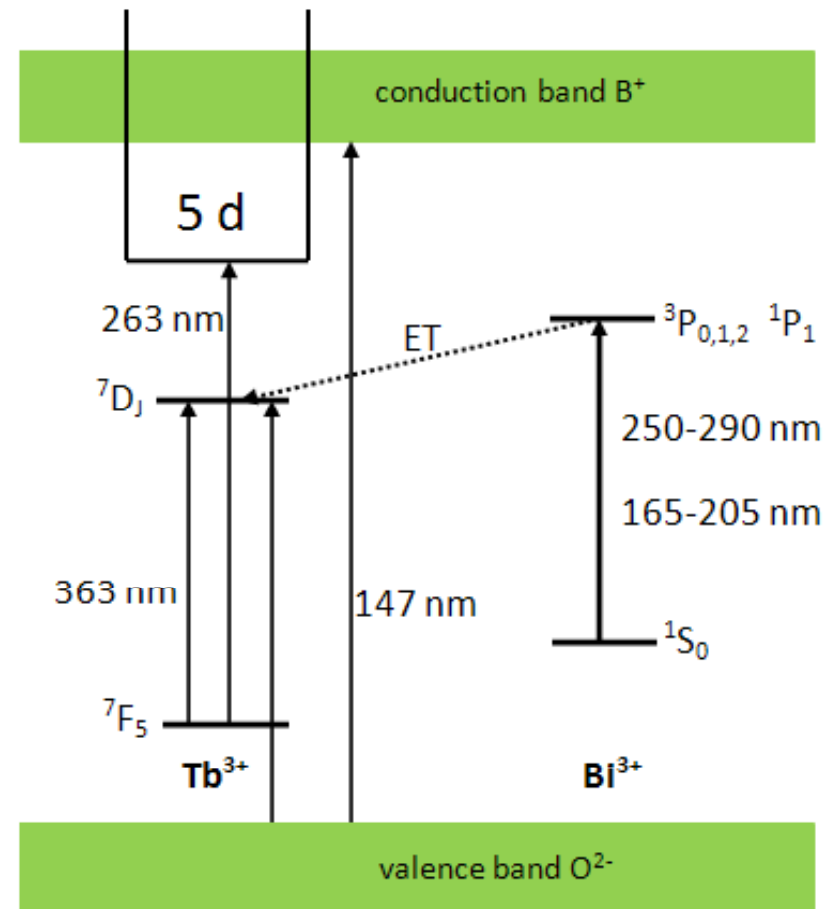


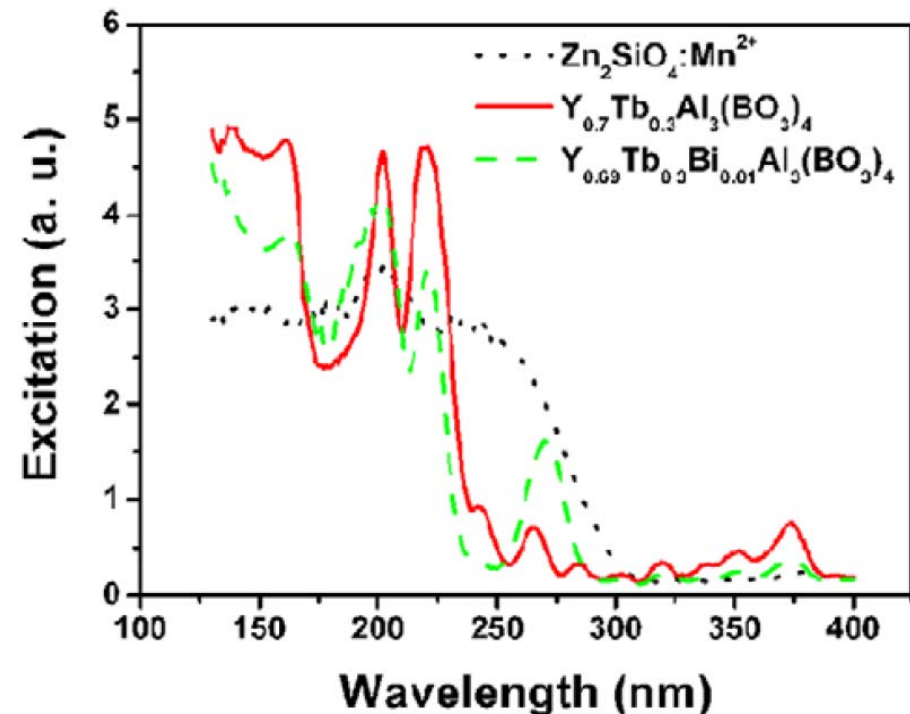
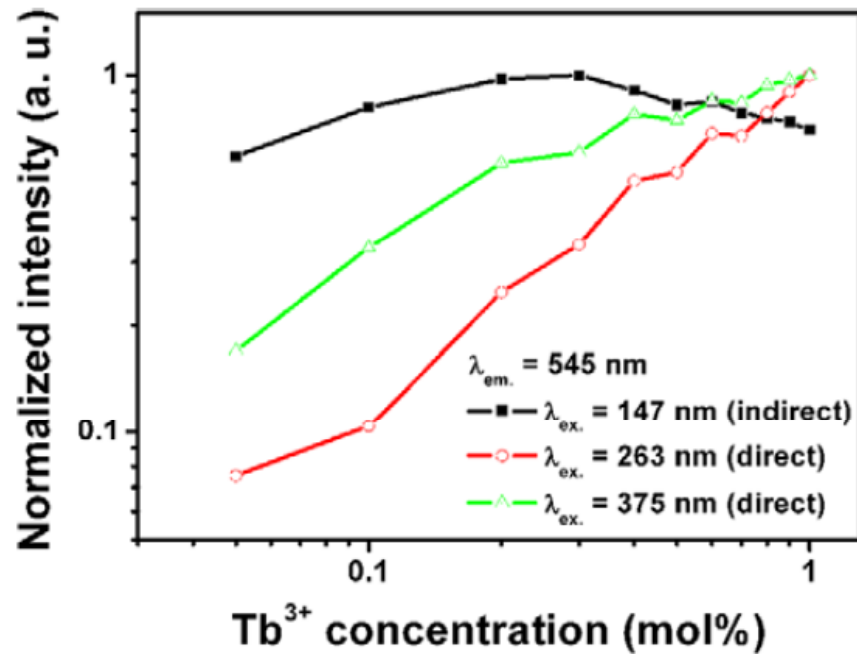
Fig. 2. The XRD patterns of the phosphor samples prepared with different firing temperatures.

- **Excitation mechanisms in $\text{YAl}_3(\text{BO}_3)_4:\text{Tb}^{3+}, \text{Bi}^{3+}$**

- Via Host lattice
- Direct excitation of activator ion (263 nm & 375 nm)
- CT from O^{2-} to activator ion or 5d band
- Energy transfer from Bi^{3+} to Tb^{3+}



- Indirect host lattice absorption is independent of Tb^{3+} concentration
- Both direct absorption mechanisms are dependent on Tb^{3+}
- Increased absorption at 172 nm by Bi^{3+} doping



- 5D_4 - 7F_5 (545nm)
 - 163% more PL intensity in comparison to $Zn_2SiO_4:Mn^{2+}$
 - Firing at $1200^\circ C$ shows best results

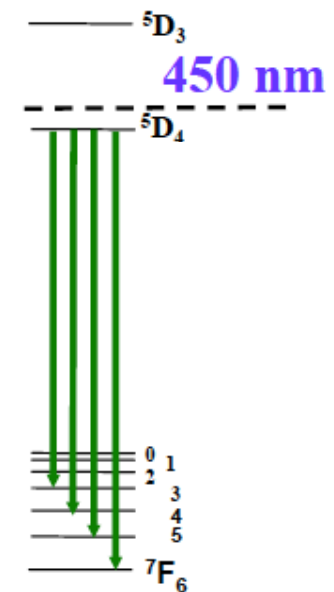
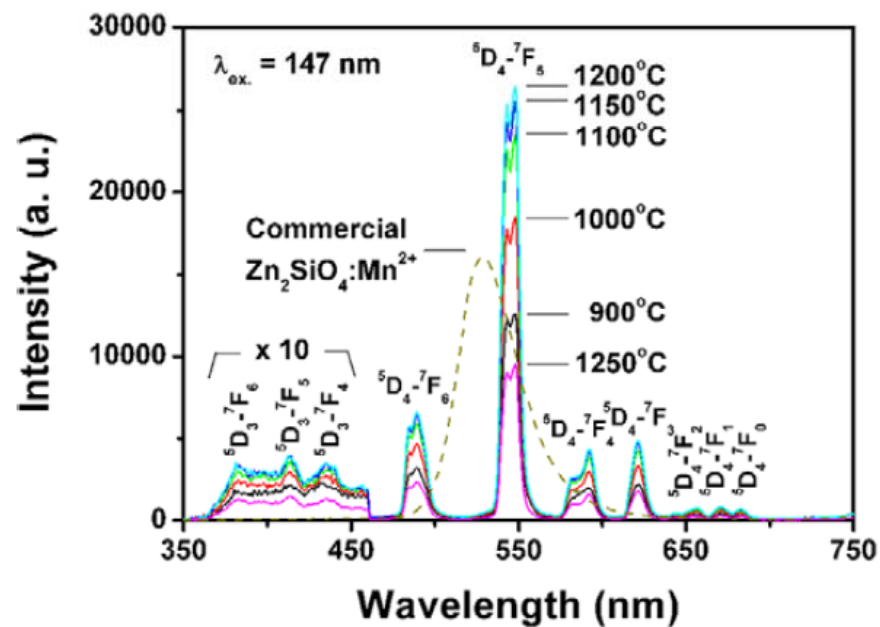
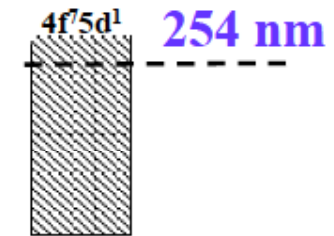


Fig. 3. The PL spectra of the $Y_{0.7}Tb_{0.3}Al_3(BO_3)_4$ samples prepared with different firing temperatures and a commercial $Zn_2SiO_4:Mn^{2+}$ phosphor.

- Increasing Tb^{3+} concentration:
 - Better decay time
 - But concentration quenching (cross relaxation) above 0.3x Tb

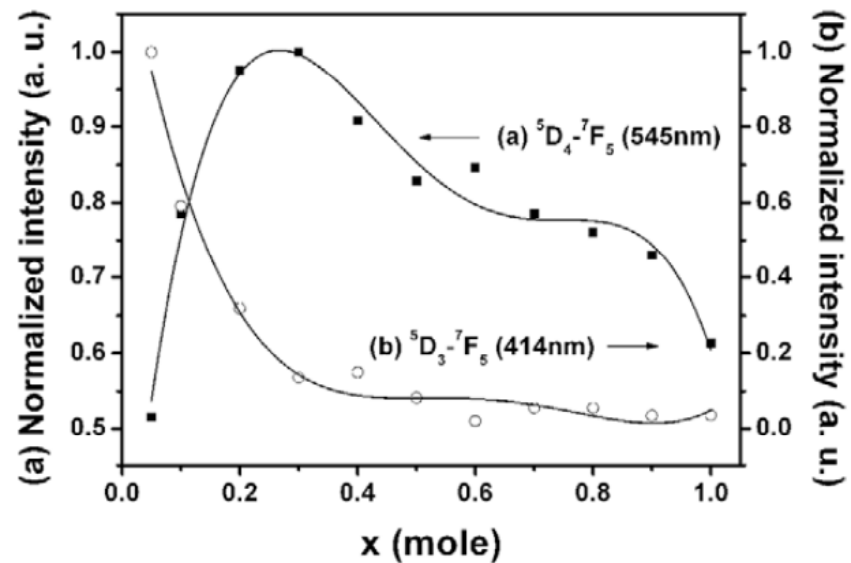
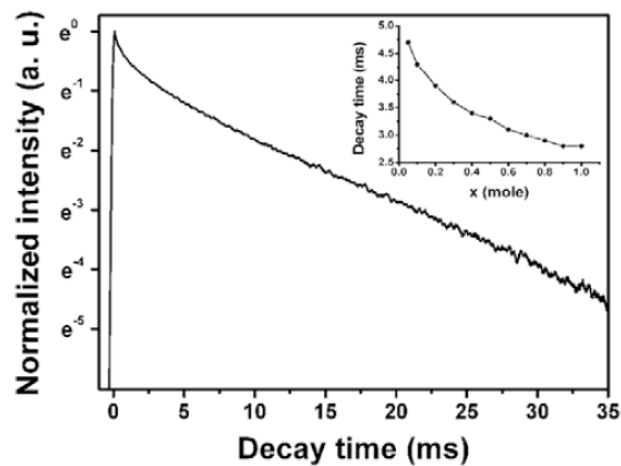
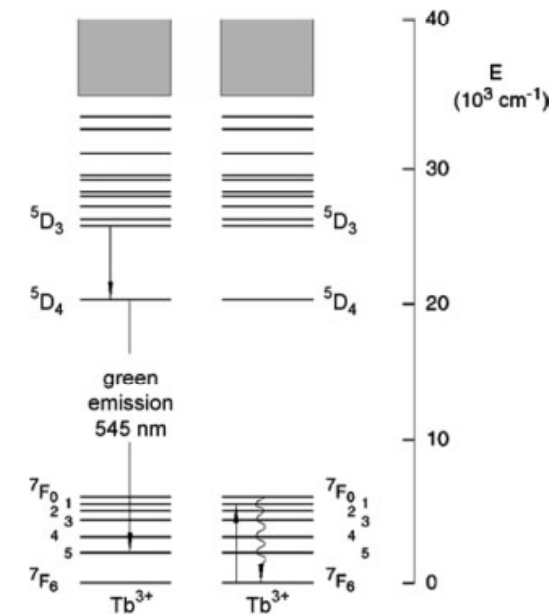


Fig. 4. The decay curve of $5D_4 - 7F_5$ transition of Tb^{3+} ion in $Y_{0.7}Tb_{0.3}Al_3(BO_3)_4$ sample. The inset shows lifetimes of the phosphor samples depending upon the Tb^{3+} ion concentration.

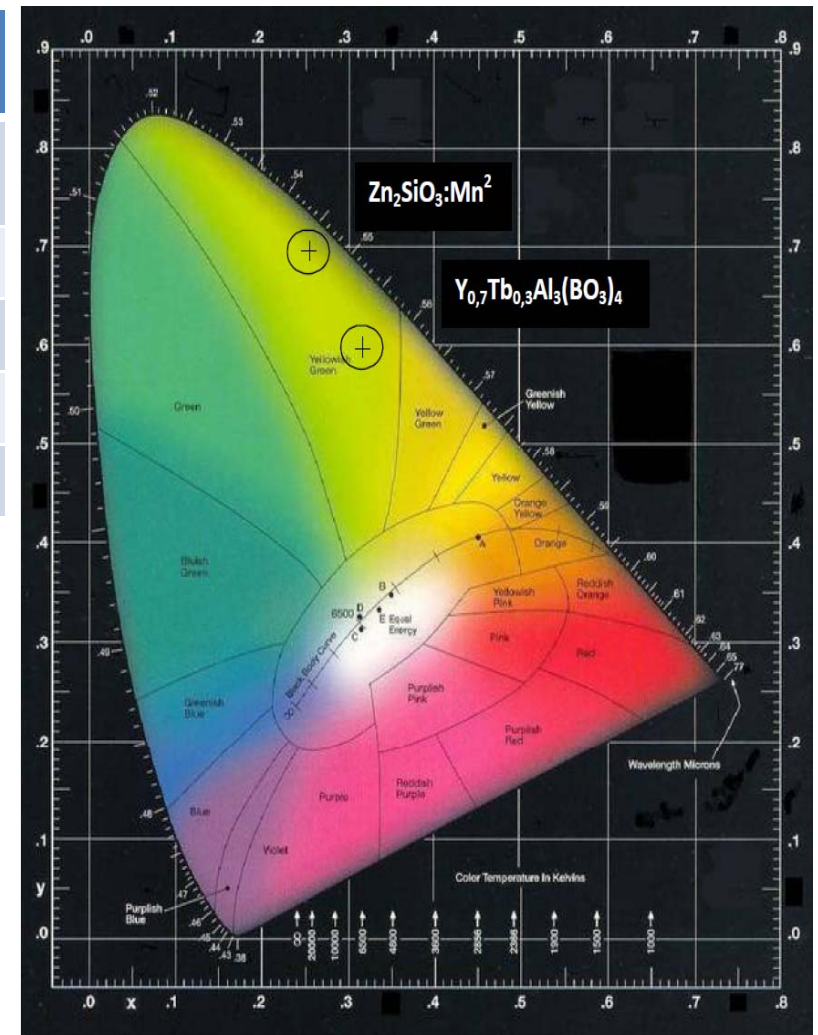
Introduction

Preparation

PL-Properties

Conclusion

Properties	$\text{YAl}_3(\text{BO}_3)_4:\text{Tb}^{3+}, \text{Bi}^{3+}$	$\text{Zn}_2\text{SiO}_4:\text{Mn}^{2+}$
Emission maximum	(545 nm) 163%	(530 nm) 100%
Decay time	3,6 ms	5,8 ms
CIE coordinate	(0.315, 0.599)	(0.256, 0.697) preferable
Brightness	74%	100%
Quenching	Yes	No



- **Excitation in PDP at 147 nm**
- **Fast decay time**
- **Bi³⁺ doping increases absorption at 165-205 nm and thus Tb³⁺ luminescence**
- **Host absorption decreased by adding Bi³⁺**
- **Emission maximum highest without co-doping (Tb_{0.3x})**
- **Inferior CIE coordinate**