**Electronic Supplementary Material (ESI) for New Journal of Chemistry.**

# Supporting Information

## Up-conversion of lanthanide Ions and Down-conversion Defect Luminescence in $BaGdF_5$:Yb,Er/Tm for Application in Anti-counterfeiting

*Wenjing Liu [a], Wenjun Zhang* [a], Ruxin Liu [a] , Guojing Li [a]*

**[a] School of Chemical Engineering, Hebei University of Technology**
**Tianjin, 300130, China.**

*** E-mail: wjzhang@hebut.edu.cn**

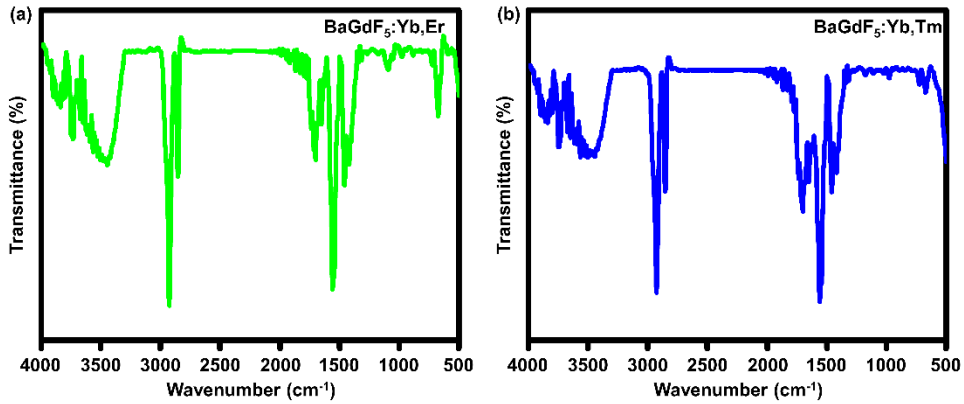


**Fig. S1 FT-IR spectra of (a) $BaGdF_5$:Yb,Er and (b) $BaGdF_5$:Yb,Tm.**

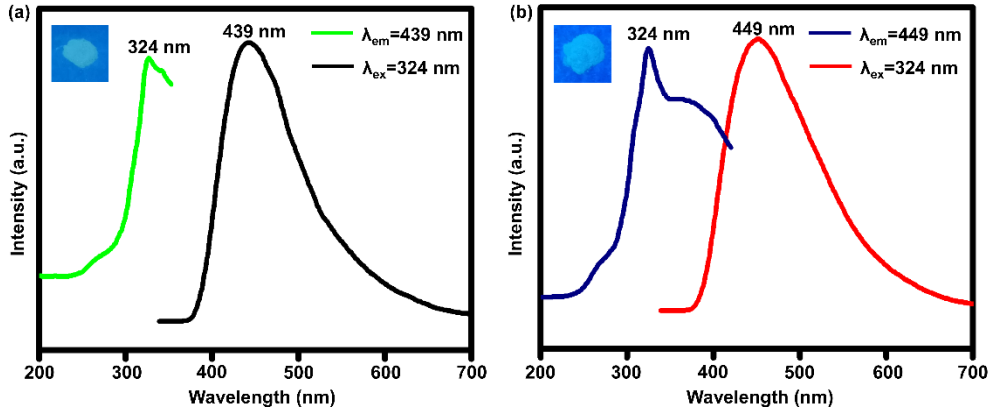


**Fig. S2 (a) Excitation spectrum ($\lambda_{em}$ = 439 nm, left) and emission spectra ($\lambda_{ex}$ = 324 nm, right) of $BaGdF_5$:Er,Tm (b) excitation spectrum ($\lambda_{em}$ = 449 nm, left) and emission spectra ($\lambda_{ex}$ = 324 nm, right) of $BaGdF_5$:Yb,Tm (the illustration is the corresponding fluorescence diagram of two solid powder samples under the excitation of 365 nm).**

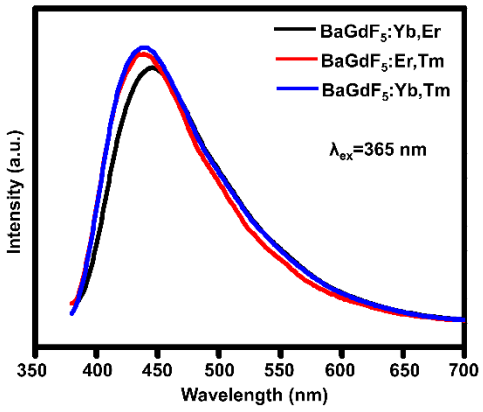


**Fig. S3 The emission spectra of $BaGdF_5$:Yb,Er, $BaGdF_5$:Er,Tm and $BaGdF_5$:Yb,Tm under the excitation of 365 nm.**

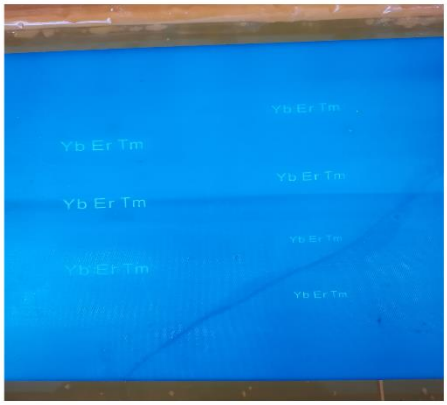


**Fig. S4 The image of screen printing plate.**