

The sensitization of the Pr<sup>3+</sup> Photon Cascade Emission in YF<sub>3</sub>

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Research in the field of vacuum ultraviolet (VUV) spectroscopy of trivalent rare earth ions continues to be of interest from both fundamental and practical points of view. The interconfiguration ( $4f^n \leftrightarrow 4f^{n-1}5d^1$ ) excitation and emission transitions in the VUV of ions such as Pr<sup>3+</sup>, Nd<sup>3+</sup>, Tm<sup>3+</sup> and Er<sup>3+</sup> were already reported in the 1970s [1]. The phosphor YF<sub>3</sub>:Pr<sup>3+</sup> is of particular interest because it is known to generate more than one visible photon for every absorbed 185 nm ultraviolet photon (quantum efficiency= 140%) [2-3]. In this talk we present a detailed characterization of the energy transfer from the  $4f^{n-1}5d^1$  state of the Tm<sup>3+</sup> and Nd<sup>3+</sup> ions to the  $4f^15d^1$  state of the Pr<sup>3+</sup> in YF<sub>3</sub>. The sensitization of the Pr<sup>3+</sup>  $^1S_0 \rightarrow ^1I_6$  emission transition when exciting the Tm<sup>3+</sup> interconfigurational  $^3H_4(4f^{12}) \rightarrow 4f^15d^1$  transition at 147 nm is exhibited in Figure 1. The various energy transfer pathways between the Tm<sup>3+</sup> and Nd<sup>3+</sup> ions that are identified in Figure 2 will be discussed in this talk.

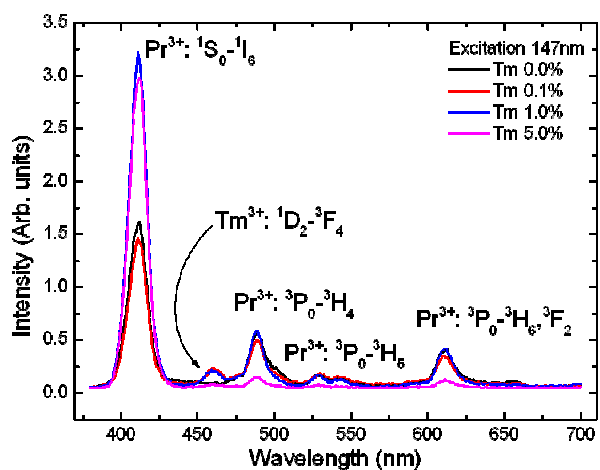


Figure 1: The room temperature emission spectra of Y<sub>0.999-x</sub>Pr<sub>0.001</sub>Tm<sub>x</sub>F<sub>3</sub> (x= 0.0, 0.001, 0.01, 0.05) ( $\lambda_{ex} = 147$  nm; Tm<sup>3+</sup>  $4f^{12} \rightarrow 4f^15d^1$ ). Note that relative to the sample containing only 0.1% Pr<sup>3+</sup>, the Pr<sup>3+</sup>  $^1S_0 \rightarrow ^1I_6$  emission is twice as intense in the co-doped sample which contains 1% Tm<sup>3+</sup>. Further note the presence of Tm<sup>3+</sup>  $^1D_2 \rightarrow ^3F_4$  emission transition at 452 nm. This will be discussed in the talk.

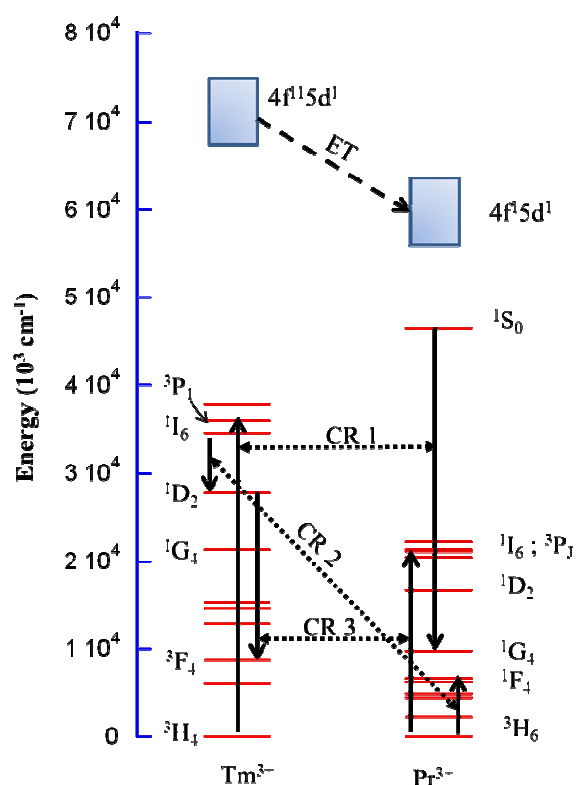


Figure 2: The energy level diagram of Tm<sup>3+</sup> and Pr<sup>3+</sup> in YF<sub>3</sub> and the energy transfer processes which occurs between the two ions. ET represents energy transfer from the Tm<sup>3+</sup> ( $4f^15d^1$ ) to Pr<sup>3+</sup> ( $4f^15d^1$ ). The cross relaxation channels (CR 1, CR 2 and CR 3) that are identified in the energy transfer process are represented by dashed arrows.

## REFERENCES

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