# **Relating thermal quenching and thermoluminescence involving lanthanides with level location in the band gap**

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The thermal quenching of lanthanide 5d-4f luminescence (Eu2+, Ce3+) and 4f-4f luminescence (Pr3+, Eu3+, Tb3+) may proceed by means of charge carrier transfer from the excited state to the host bands. The reversed transfers to the ground states occur in trapping of electrons by trivalent lanthanides (Pr3+, Nd3+, Sm3+, Eu3+, Dy3+, Ho3+, Er3+, Tm3+, Yb3+) or holes by trivalent lanthanides (Ce3+, Pr3+, Tb3+). Both processes are of crucial importance for the performance of luminescence, scintillator, dosimetry, afterglow, and storage phosphors. Data on quenching temperatures [1] and thermoluminescence gathered from literature involving 36 different compounds have been analyzed to obtain the quenching energy barriers ΔEq and the electron trapping depths ΔEe-trap and hole trapping depths ΔEh-trap. This will be compared with the energy barriers and trapping depths read from the Vacuum Referred Binding Energy diagram constructed for each compound. On the one hand very good correspondence was found, on the other hand systematic differences were revealed. This means that the validity of the VRBE diagrams is further confirmed but also that accuracy is limited to few 0.1 eV.



Fig. 1 VRBE diagram of hypothetical compound illustating the average differences (in purple colour) betweenVRBE prediction and experimental quenching barriers and carrier trap depths

## **References**

[1] P. Dorenbos, J. Mater. Chem C. (2023) DOI: 10.1039/d2tc04439k