

Principles, analytical methods and mechanisms of phototransferred thermoluminescence of calcite

M L Chithambo

*Department of Physics and Electronics, Rhodes University, PO BOX 94, Makhanda 6140,
South Africa*

Calcite, as do all carbonates, derives from the $(\text{CO}_3)^{2-}$ anion. Calcite produces intense luminescence (TL) which is mostly attributed to presence of Mn^{2+} anions. The emission spectra of calcite [1] and carbonatite [2] consist of broadband features at lower temperatures and line structures at high temperatures. These wavelength multiplexed differences are attributed to the solubility of Mn within calcite [1]. Although there has been considerable progress in understanding mechanisms of TL in calcite, corresponding advance related to optical stimulation has been slow. In this study we combine the utility of optical stimulation with the facility of thermal stimulation to study the phototransfer (PTTL) in calcite induced by 470 nm blue-, 525 nm green- and 405 nm illumination. PTTL time-response profiles, that is, the dependence of PTTL intensity on the duration of illumination, are analysed using an eigen-value method, by use of vector fields and by theoretical modelling. We also address backscattering to donor traps and competition effects, where supposed donor electron traps suppress electron trapping at acceptor electron traps. The PTTL induced from deep electron traps by 405 nm illumination counterintuitively increases monotonically. We consider the extent to which this behaviour reflects the effect of emission over a range of excited states as predicted by the modified Orgel (1955) diagram rather than the principle $^4\text{P}(^4\text{T}_{1g})$. The long term behaviour of the PTTL as studied by stability theory shows unstable critical points. The significance of this will be discussed.

References:

- [1] P.D. Townsend et al., *Radiat. Meas.* **1994**, 23, 433–440.
- [2] M.L. Chithambo et al. *J. Lumin.* **2014**,145, 180 – 187.