# A new approach to analyzing the results of basic thermoluminescence methods

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The probability per unit time of release of an electron from a trap is assumed to be described by the well-known Arrhenius equation:

$$p = s exp\left(-\frac{E}{k_B T}\right)$$

where $s$ is called the frequency factor or attempt-to-escape factor, $E$ is the thermal trap depth, i.e. the thermal activation energy needed to release an electron from the trap to the conduction band, $k_B$ is the Boltzmann constant, and $T$ is the absolute temperature. The reciprocal of this probability is interpreted as the lifetime of traps at temperature $T$, which is a critical parameter used to characterize scintillator and dosimetric materials.

The Variable Heating Rate (VHR) method, also known as the Hoogenstraaten's method [1], as well as the Isothermal Decay (ID) of thermoluminescence (TL) or optically stimulated luminescence (OSL) signal [2,3], are two fundamental methods that allow the determination of trap parameters. The typical approach to interpretation of the results of these methods, which one has traditionally been used for many decades, is based on linear regression. Unfortunately, while the precision of the energy determined in this way is relatively good, the uncertainty of the frequency factor is significant, typically larger than the value of determined parameter, thus resulting in a huge error in lifetime estimation.
In this communication, we present the results of non-linear regression applied to VHR and ID measurement data. The analysis using the presently available numerical tools enables the fitting of trap parameters with much better precision than the linear regression, resulting in more accurate lifetime estimation.

[1] Hoogenstraaten W. (1958), Philips Res. Rep.,**13**, 515-693.
[2] McKeever S.W.S. (1985), "Thermoluminescence of Solids", Cambridge University Press.
[3] Chen R. and McKeever S.W.S. (1997), "Theory of Thermoluminscence and Related Phenomena", World Scientific.

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