Field-enhanced electron capture by iron impurities in germanium

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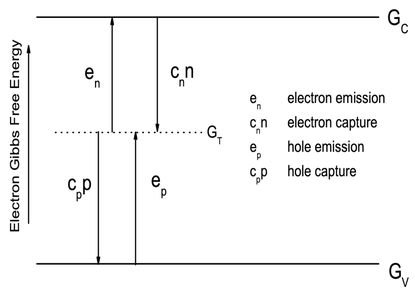
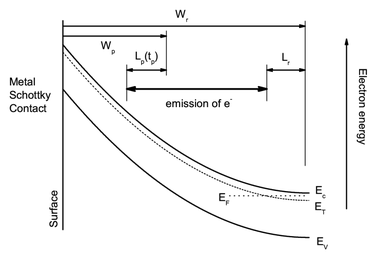
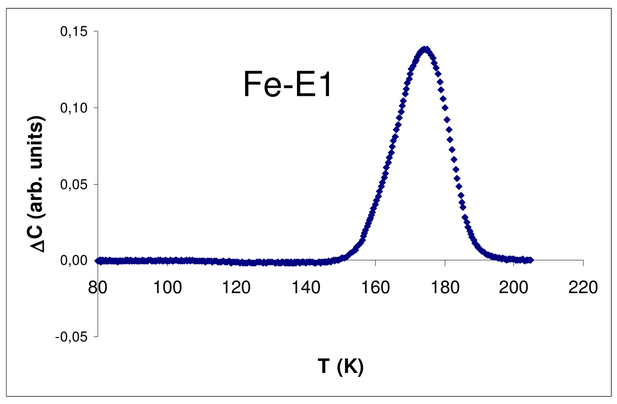
Conventional DLTS

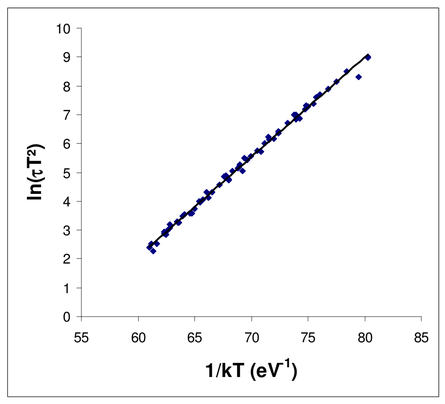
Capture versus Emission





Analysis of the emission of e^- from $Fe^{2-/-}$





$$\frac{1}{\tau} = \sigma(\varepsilon) N_C v_{th} e^{\frac{-\Delta E(\varepsilon)}{kT}}$$

$$\ln(\tau T^2) = \frac{\Delta E(\varepsilon)}{k}\frac{1}{T} - \ln(K_T(\varepsilon))$$

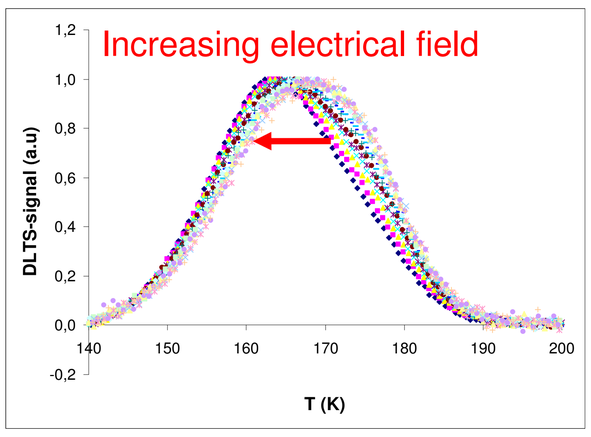
Slope

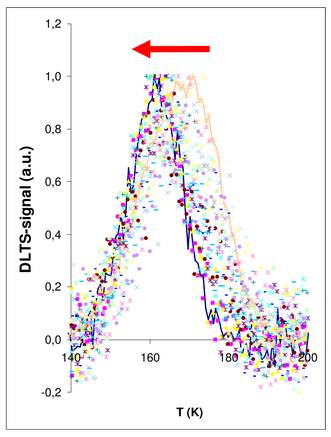
Intercept

(K_T,ΔE) signature of the electrical properties of a defect level

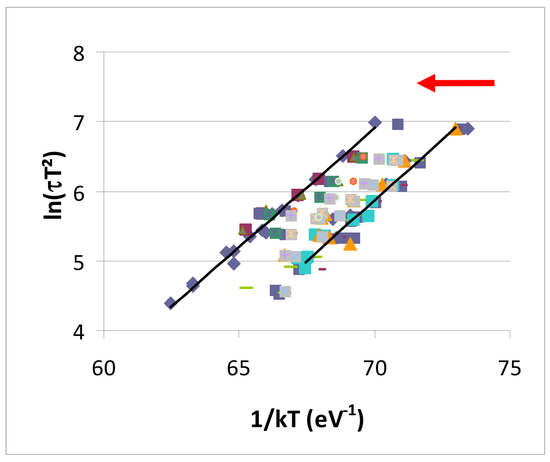
Influence of electric field

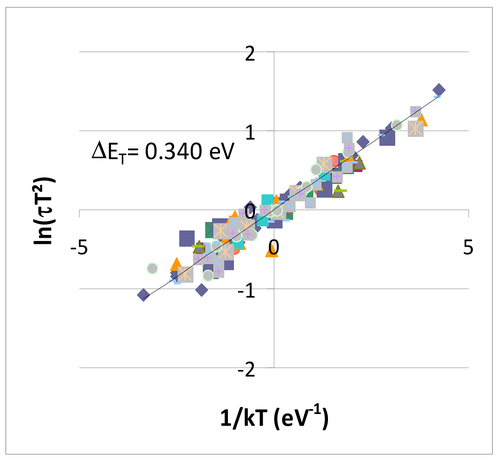
Observed conventional DLTS peak shift



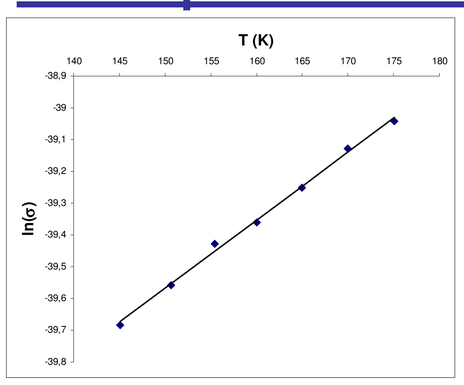


Analysis of the measured time-constant



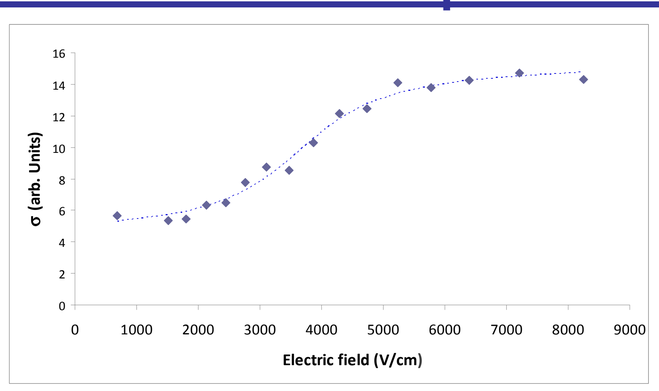


Temperature and field dependence of capture cross-section



$$\sigma(T) = \sigma_\infty \exp\left(\frac{-\Delta E_\sigma}{k_B T}\right)$$

Capture in the neutral semiconductor



$$\sigma(\varepsilon) = A\tan^{-1}\left(\frac{\varepsilon - a}{b}\right) + B$$

Pre-exponential factor of emission from a region with electric field

Conclusions

Data analysis revealed that an electric field affects the electron emission rate of $Fe^{2-/-}$ mainly through the pre-exponential factor, which is proportional to the capture cross section. An empirical electric field dependence of the electron capture cross section for a negatively charged iron impurity was deduced.