Interested in two different group of quantities

- ➢Intensity in every possible terms (quantifying TL)
- ➢Characteristics of the TL peak for understanding the mechanism as well as for assessing the lifetime of each trap

→ Activation Energy

→Frequency Factor

→Order of kinetics

Quantifying luminescence

- The simplest method to quantify the TL/OSL signal is to measure the integral of the emitted light over a temperature/stimulation time interval.
- This quantification is correct, providing that there is no overlapping between different components/peaks. Moreover, the exact integration limits should be known with great accuracy.
- Another way is measuring the peak height of the dosimetric peak. This method has some possible disadvantages. At low doses, the peak height can suffer from statistical fluctuations much greater than for an integrated TL signal, and in the case of complex glow curves, the peak height may be influenced by neighboring/overlapping peaks whose dosimetric characteristics are different.

De-convolution

- Quantitative isolation – separation of the luminescence signal of each component based on analytical models
- Model dependent procedure since various peak shape methods can be used
- Time-consuming
- Has the potential of delivering the greatest amount of information with great precision and accuracy
- The most frequently peak shape methods used include various combinations of first-order, second-order, mixed-order and ***general-order kinetics***

(*Horowitz and Moscovitch, Rad. Prot. Dos. 153, 1–22, 2013*)

Equation for TL glow curves; crystals

$$I(T) = I_m \cdot b^{\frac{b}{b-1}} \exp\left(\frac{E}{kT}\frac{T-T_m}{T_m}\right) \cdot \left[(b-1)(1-\Delta)\frac{T^2}{T_m^2}\exp\left(\frac{E}{kT}\frac{T-T_m}{T_m}\right) + Z_m\right]^{-\frac{b}{b-1}}$$

$\Delta = 2kT/E$, $\Delta_m = 2kT_m/E$ και $Z_m = 1 + (b-1)\,\Delta_m$.

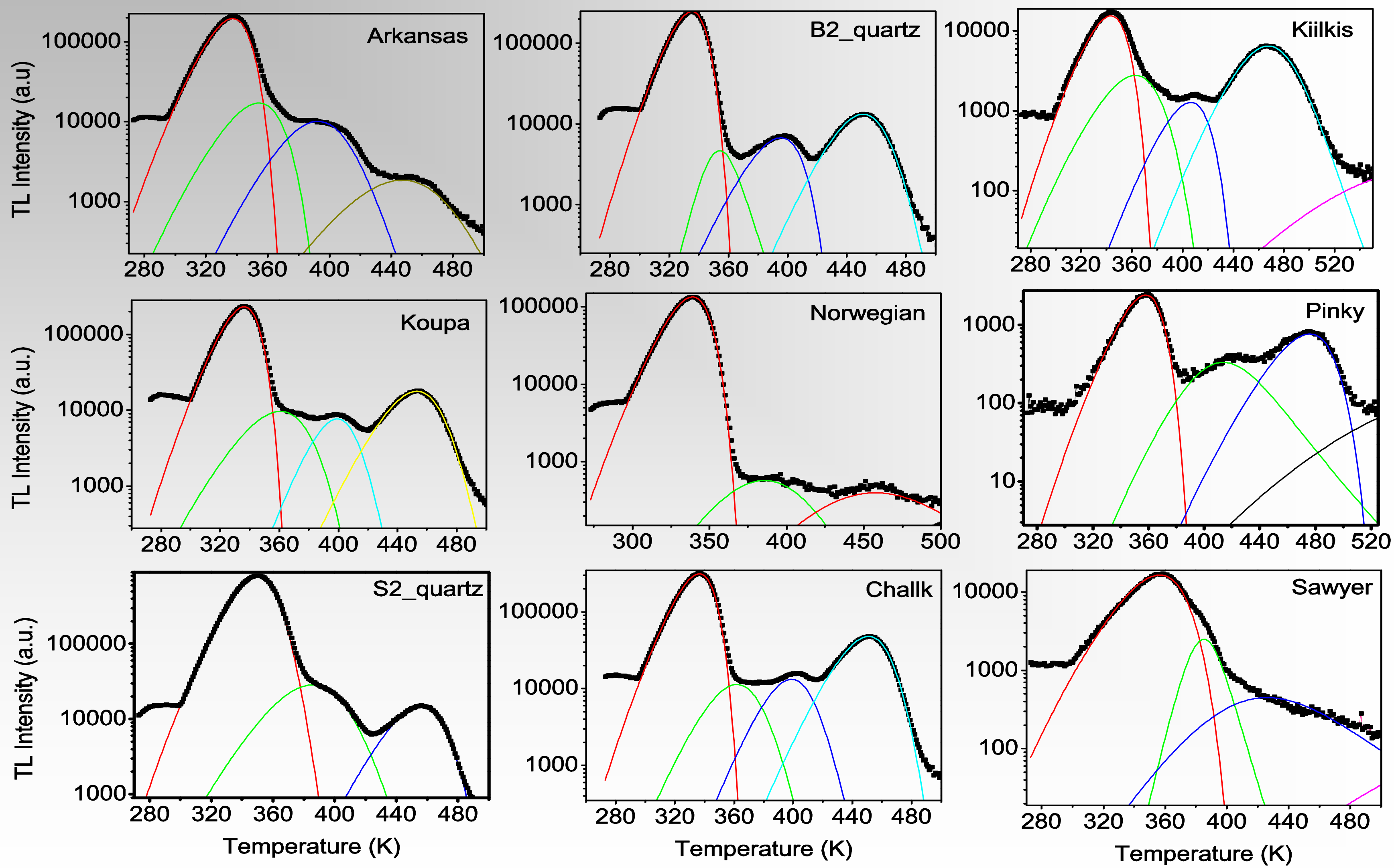
- Fitting parameters

1. T_{max} = temperature where the signal gets its maximum value
2. b = kinetic order (ranging between 1 and 2)
3. E = activation energy of the trap
4. I_{max} = maximum intensity of the peak

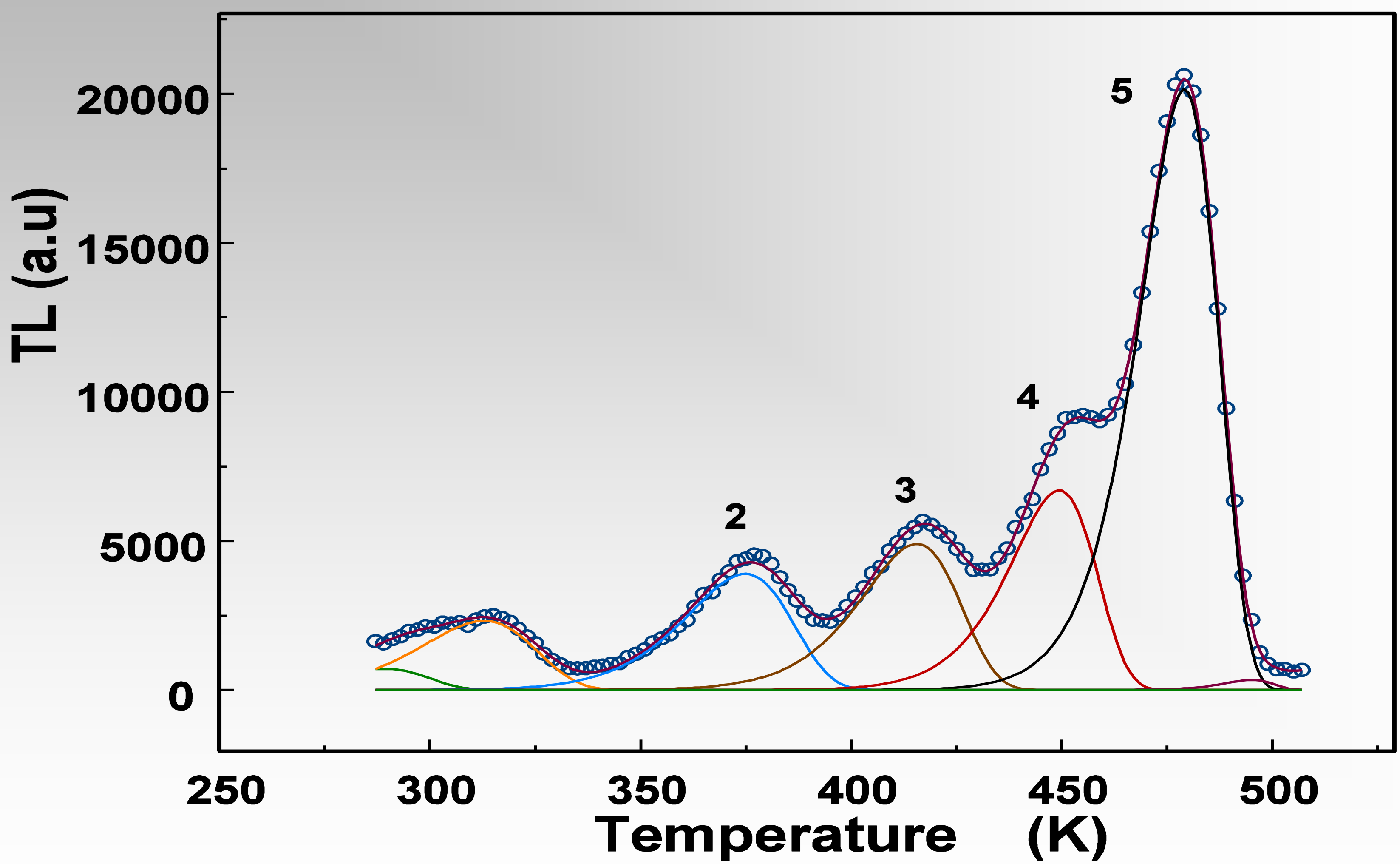
Independent variable: Temperature T

(*Kitis et al., J. Phys. D-Appl. Phys. 251, 133–142, 2006*)

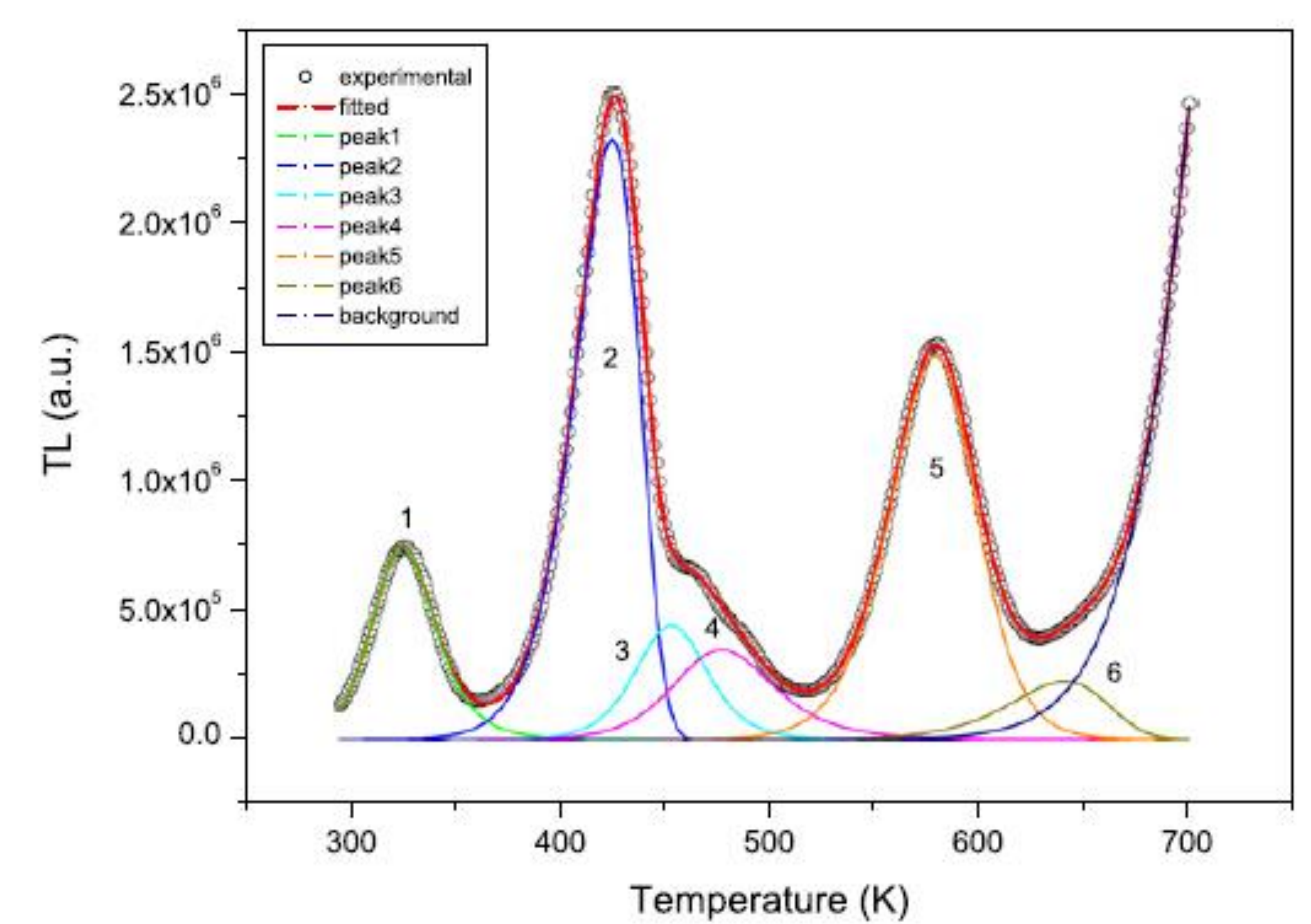
Deco examples: Quartz



Deco examples: LiF:Mg,Cu,P



Deco examples: $KMgF_3:Ce^{+3}$



Equation for TL glow curves; amorphous

$$I(T) = I_{\mathrm{m}} \cdot \frac{T_{\mathrm{m}}}{T} \cdot \frac{1-\Delta_{\mathrm{m}}}{1-\Delta} \cdot [\exp\{(T/T_{\mathrm{m}})\exp(u_{\mathrm{eff}})\exp(-w)\} - \exp\{(T/T_{\mathrm{m}})\exp(u_{\mathrm{eff}})\exp(w)\}][\exp\{-(1-\Delta_{\mathrm{m}}) \times \exp(-w_{\mathrm{m}})\} - \exp\{-(1-\Delta_{\mathrm{m}})\exp(w_{\mathrm{m}})\}]^{-1}, \quad (3)$$

$$\Delta_{\mathrm{m}} = 2kT_m/E_{\mathrm{eff}}, \qquad u_{\mathrm{eff}} = E_{\mathrm{eff}}(T - T_{\mathrm{m}})/kTT_{\mathrm{m}},$$

$$w = \Delta \mathrm{E}/kT \quad \text{and} \quad w_{\mathrm{m}} = \Delta \mathrm{E}/kT_{\mathrm{m}}.$$

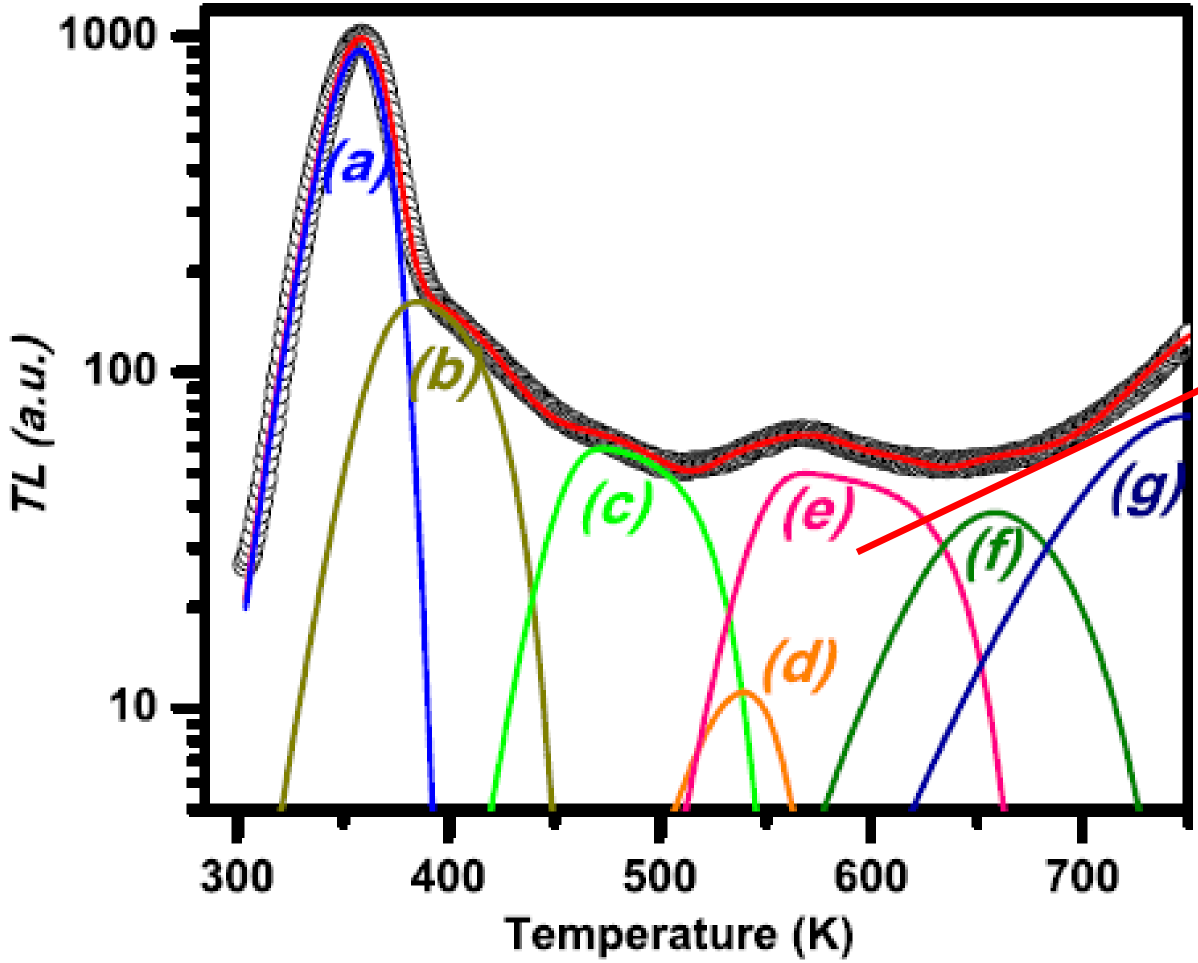
- Fitting parameters

1. T_{max} = temperature where the signal gets its maximum value
2. E = activation energy of the trap
3. ΔE = finite energy range
4. I_{max} = maximum intensity of the peak

Independent variable: Temperature T

(*Kitis and Gomez-Ros, NIM A. 440, 224–231, 2000*)

Deco examples: 58S biomaterial



Trapezoidal

→ ***Distinguishing between crystalline and amorphous phases***

(*Polymeris et al., J. Phys, D – App. Phys.. 44, 395501, 2011*)