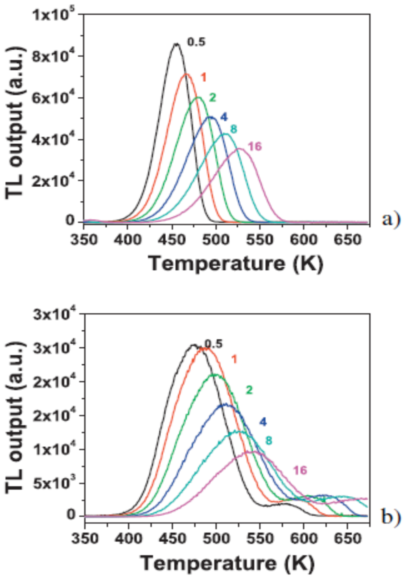
Retrospective Dosimetry

TRUE or FALSE?

1. For a material with 3 traps the TL glow curve indicates 2 peaks.
2. For a material with 3 traps the TL glow curve indicates 4 peaks.
3. For a material with 3 traps the TL glow curve indicates 3 peaks.
4. If the TL glow curve of a material shows 2 peaks, then the material has only 2 traps.
5. If the TL glow curve of a material shows 2 peaks, then the material has at least 2 traps.
6. If the TL glow curve of a material shows 2 peaks, then the material has only 3 traps.
7. Each TL glow curve consists of at least one TL glow peak.
8. All naturally occurring TL phosphors exhibit complex TL glow curves, consisting of several prominent (easy to identify) as well as a number of hidden (shoulder) TL peaks.
9. The emission of luminescence becomes possible because of the presence of defects in the materials' structure.
10. All TL peaks are symmetric, so these can be fitted using Gaussians.
11. All TL peaks are asymmetric, so these can be fitted using Gaussians.
12. All TL peaks are asymmetric, so these can not be fitted using Gaussians or Lorentzians.
13. Each TL trap is characterized by a unique lifetime according to the equation: $\tau = s^{-1} \cdot e^{\frac{E}{kT}}$
14. For $\tau = s^{-1} \cdot e^{\frac{E}{kT}}$ E stands for the frequency factor while s for the activation energy.
15. In all cases of first, second and general order of kinetics, the TL equation includes the term $e^{\frac{E}{kT}}$.
16. In all cases of first, second and general order of kinetics, the TL equation includes the term $e^{\frac{-E}{kT}}$.
17. For all TL glow curves the initial increasing part is dominated by the exponential term, while the final decreasing part is governed by an exponential integral term.
18. If a TL peak corresponds to a trap with a lifetime of 10 hours, then 100 hours after irradiation this specific TL peak disappears.
19. Activation energy stands for the energy required so that the electrons go out from the trap and go to the conduction band.
20. Activation energies in normal TL materials are some electronvolts (eV).
21. Activation energy can be calculated using several methods, such as initial rise technique, fractional glow technique and deconvolution.
22. Imax stands for the maximum temperature position of each TL glow curve while Tmax for the maximum intensity.
23. Tmax stands for the maximum temperature position of ach TL glow curve while Imax for the maximum intensity.
24. In order to apply the initial rise technique, we just need one TL measurement.
25. While applying the initial rise technique, we plot the 1/kT versus the ln(TL); then the slope of this linear plot is the activation energy.

26. The initial rise technique can give not only the activation energy, but also the order of kinetics parameter b.
27. In order to apply the initial rise technique, the entire glow curve is required.
28. Fractional glow technique could be considered as a multiple initial rise technique.
29. In order to apply the fractional glow technique, we just need one TL measurement.
30. The frequency factor is related to the entropy of the material.
31. The fractional glow technique gives two types of information mostly: how many traps/peaks we have in a glow curve and the values of the activation energies for each trap.
32. For the application of fractional glow technique, we plot the E values versus temperature and we are looking for the plateau regions.
33. For calculating the activation energy for the case of the various heating rates method, we do not use the intensity of the TL glow curves but only the Tmax position shift of the peaks.
34. For TL deconvolution, special mathematical models were adopted.
35. In the equation describing thermoluminescence, the heating rate is an important parameter which acts as normalization factor so that the term including the exponential integral gets the value of 1.
36. For the supralinearity index f(D), when f(D)<1 then the dose response is sublinear, when when f(D)>1 supralinear and when f(D)=1 linear.
37. When TL is measured for the same material using various heating rates, the Tmax position of each peak is shifted to higher values.
38. In the presence of thermal quenching, the Tmax values are not changed.
39. In the presence of thermal quenching, the parameters Imax and FWHM are changed in a way so that the total TL integral stays unaffected.
40. In the absence of thermal quenching, the parameters Imax and FWHM are changed in a way so that the total TL integral stays unaffected.
41. In the absence of thermal quenching, the Imax is increased with increasing heating rates.
42. The material of the following figure yields strong anomalous fading.

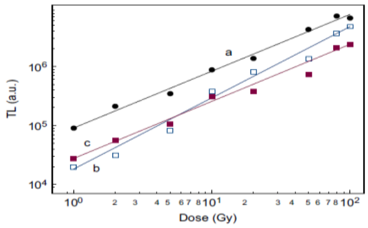


43. Phosphorescence is a spontaneous procedure, independent on the stimulation temperatures.

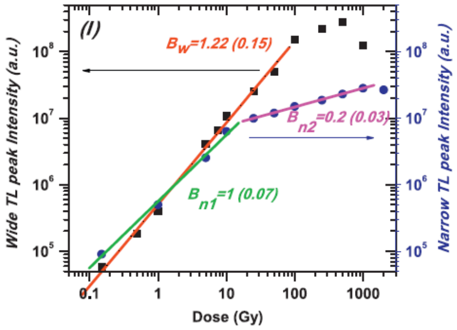
44. One TL glow curve indicates three different TL glow peaks, P1, P2 and P3 at T1=125°C, T2=209°C and T3=324°C. Among these three TL peaks the second one is the most stable.
45. Sensitization is defined as the luminescence output (signal/integral) per unit of mass per unit of dose, while the sensitivity is the change of the sensitization.
46. Sensitivity is defined as the luminescence output (signal/integral) per unit of mass per unit of dose, while the sensitization is the change of the sensitization.
47. Which is the correct sensitivity unit, counts·mg·Gy or counts/(mg·Gy)?
48. Aluminum oxide is known for its thermal quenching effect and quartz for its sensitization, especially for the 110°C TL peak.
49. Theoretically, the dose response curve yields an initial supralinear area, then a linear one, a sublinearity region because of saturation and finally possibly an area due to saturation damage.
50. For the three TL peaks of question 34, use the appropriate symbol (<, = or >) to characterize the following parameters:

    E1 E2 E3
    τ1 τ2 τ3
    Tmax1 Tmax2 Tmax3
    P1 P2 P3

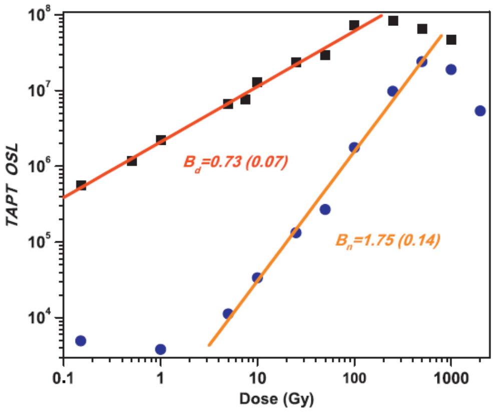
51. All dose response curves of the following figure are linear.



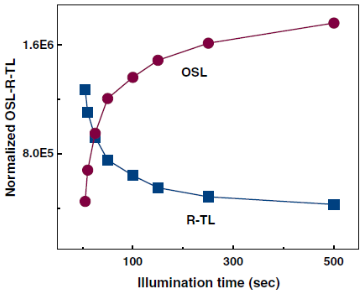
52. Characterize the areas of the following dose response curves:



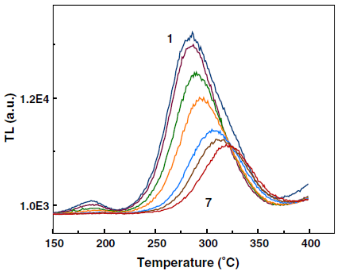
53. In the following figure, there is not any linear dose response part.



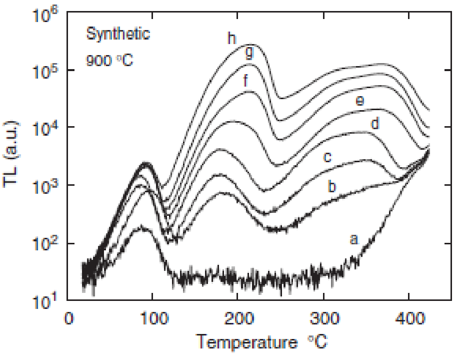
54. We make OSL measurements to the same material with increasing OSL time. The OSL and residual TL (RTL) signals versus the OSL stimulation time are presented correctly in the following figure.



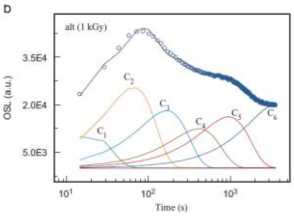
55. The following figure presents TL measurements after OSL at various increasing stimulation times. Glow curve 1 corresponds to longer stimulation and curve 7 to shorter OSL time.



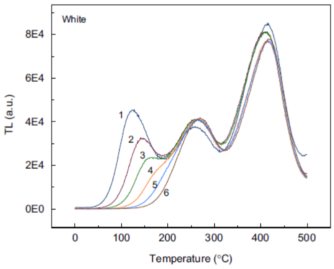
56. The following figure presents TL glow curves of synthetic quartz for various doses. Curve (a) corresponds to zero dose and curve (h) to the highest dose.



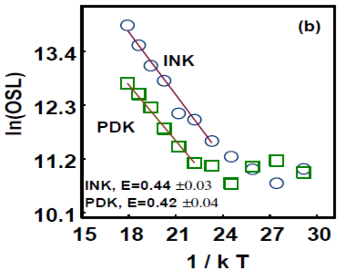
57. The following figure presents LM-OSL curve de-convolved to its individual OSL components.



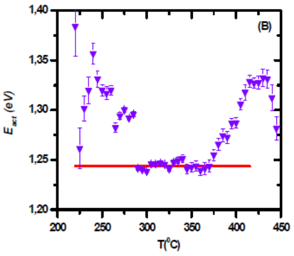
58. The following figure presents TL glow curves within a thermal cleaning experiment.



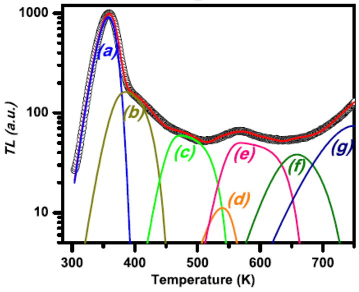
59. The following figure presents an Arrhenius plot for the calculation of the activation energy.



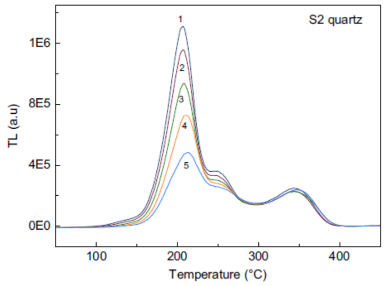
60. The following figure presents the results of the fractional glow technique.



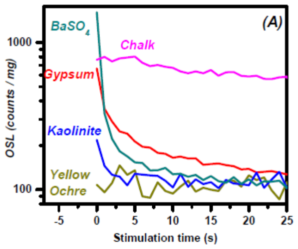
61. In the following plot, TL peak (a) corresponds to crystalline material while TL peak (e) to amorphous material.



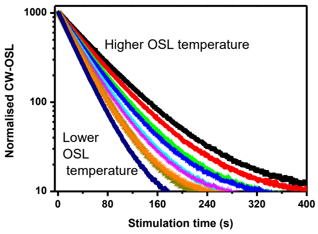
62. Luminescence is effectively used to date metals.
63. If we have residual TL after OSL like the following plot, then the TL peak around 350 °C is not affected by OSL.



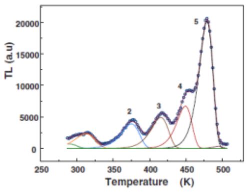
64. In the following figure, chalk yields the most appropriate OSL signal for luminescence dating.



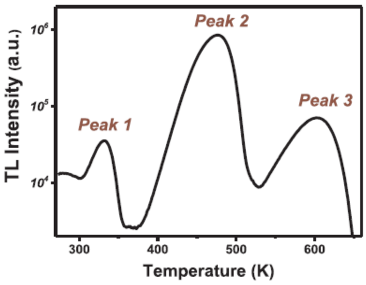
65. The following figure presents CW-OSL curves measured at various OSL temperatures.



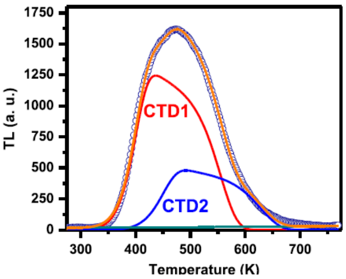
66. The following figure presents a typical TL glow curve for LiF:Mg,Ti material.



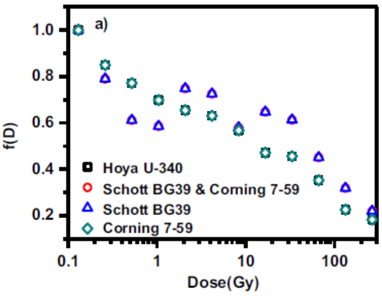
67. In the following figure peak 2 is the most intense but peak 3 is the most stable



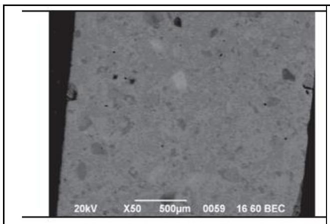
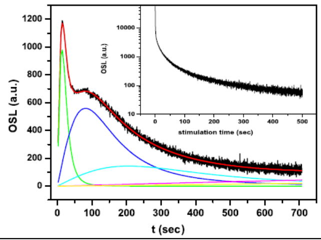
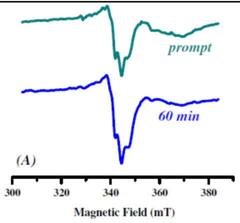
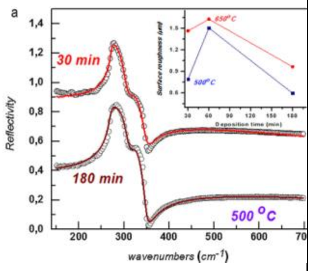
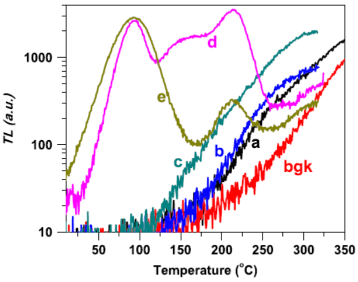
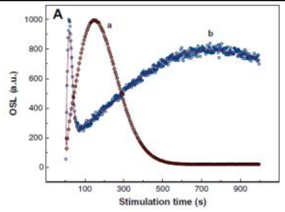
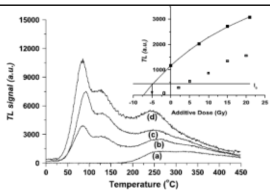
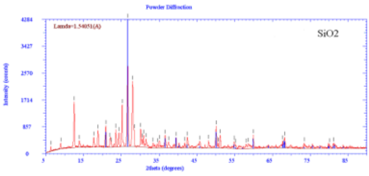
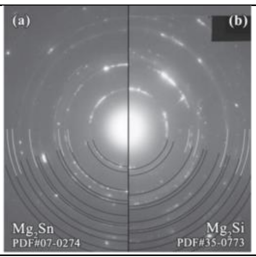
68. The following figure presents a typical glow curve of amorphous material



69. The supralinearity index of the following figure indicates that the dose response throughout the entire dose region is linear.



70. In the following table indicate which plots present luminescence measurements and also explain the type of luminescence.

I. Plot the graphics of Im, Tm, FWHM and integrated TL peak signal for the case of Al_2O_3:C, a material with strong thermal quenching.

II. Material has 5 traps with activation energies 0.66 eV, 0.85 eV, 1.25 eV, 1.88 eV and 2.8 eV. For this material indicate which of the following is true or false.

II1. Blue OSL (E_{blue}=2.38 eV) stimulates energy from all 5 traps.

II2. IRSL (E_{IR}=1.41 eV) stimulates only the first three traps.

II3. The TL glow curve of the materials up to 500 °C yields 5 TL peaks.

II4. The number of TL peaks in the TL glow curve depends strongly on the heating rate of the material.
II5. The TL peak with activation energy 0.66 eV is the most stable.
II6. The TL peak with activation energy 0.66 eV corresponds to the lowest Tmax among all other TL peaks.
II7. The lifetime of the TL peak with 1.25 eV is higher than of the peak with E=1.88 eV but lower than the peak with 0.85 eV.
II8. The trap with activation energy of 2.8 eV is the deepest trap of the material.
II9. OSL, IRSL and TL fail to stimulate electrons from very deep traps.
II10. Only the first two peaks can be used effectively for dosimetry purposes (0.66 eV, 0.85 eV).

III. In the case of isothermal TL, as the measurement temperature increases, so does the slope of the measurement at a semi-log axis.

IV. Describe in short how we can calculate the activation energy from isothermal TL measurements.

V. In the deconvolution procedure, the n_0 and the s are normal fitting parameters.