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ORIGINAL ARTICLE

SPREADSHEET PREPARATION FOR THE TL MATERIAL $CaSo_4$: DyUSING GENERAL ORDER KINETICS METHOD

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ABSTRACT

The thermoluminescence material CaSo_4 :Dy has been prepared by the acid evaporation method and this thermoluminesce material CaSo_4 :Dy is used to get a glow peak at a 500°C obtained by the heating rate of 5°c/s. the thermoluminescence material can read from RISO TL reader. From the glow curve, we can take the values of Tm(maximum temp) and Im (maximum intensity) for each peaks if activation energy(E)and (b) order of kinetics values are the assumed values. For the deconvulation a glow curve to find out the parameters of thermoluminescencematerialCaSo_4 :Dy, one has to do the spreadsheet preparation using that we can find out the peak values, fitted intensity values, sum values, figure of merit values under GOK model.

Keywords: Thermoluminescence material, Acid evaporation method,CaSo_4 ,Dy; GOK model.

1.INTRODUCTION

'Luminescence' exists in nature as a glow from plants, insects, fishes etc. when a certain materials absorb some energy, it may reemit the absorbed energy in the form of electromagnetic energy in the visible region or near visible region and it is termed as 'Luminescence'. The materials which emit light in the visible range are termed as 'Luminescent phosphor' or simply termed as 'phosphor'

The thermoluminescence material CaSo_4: Dy has been prepared by the acid evaporation method and this thermoluminesce material CaSo_4 :Dy(Kamal et al., 2004)

The steps needed to a CCD analysis with an excel spreadsheet (Afouxenidis et al., 2012) are shown in table. The example used is that of a complex TL glow curve consisting of two individual peaks using the GOK expression

In the first step, one ascribes the temperature and TL intensity of the experimental glow curve[Puchalska and Bilski,2015] to the columns A and B.in the second step, the subsequent columns C and D are ascribed to each one of the individual peaks 1 and 2, respectively. For the fitting (Puchalskaand Bilski.P, 2015) procedure, one has to initial, arbitrary but meaningful values for the parameters Im, Tm, E and b for each single glow-peak .As can be seen in table1, these values are inserted in the rows 5-8 respectively in column C for the first peak and column D for the second peak.[Kltis et al., 1998).

The TL intensity versus temperature is called the glow curve (Puchalska and Bilski, 2005). From the glow curves we can evaluate TL parameters. The main goal of measuring and analyzing these glow curves is the extraction of several parameters that can be used to describe the TL process in the material

2.GOK ANALYTICAL EXPRESSIONS

When the curve fitting procedure is completed, it gives the net values of Im, Tm, E and b, However, the evaluation of additional quantities such as the integral of each glow-peak, the frequency factor and figure- of merit (FOM) values (Puchalska and Bilski,2005) is also feasible.

In the next step, the raw experimental data are inserted in the same spreadsheet in a way that the first data point appears in the 19th row of columns A and B, Following that, the GOK (Pagonis et al., 2006] analytical exp:
Has to be written in excel format in cell C19, It will be used to reproduce the first (lower Tmax) peak in column c by

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dragging it to the entire column c. Therefore a peak for the entire temperature region is calculated, according to the temperature T (k) and its four trapping parameters that were preselected. This procedure is repeated for the next glow peak in column D, by copying and pasting the same expressions to cell D19 and dragging it to the entire corresponding column

In that way, two arbitrary glow peaks are created without any other limitation. However, the sum of these peaks should be similar to the total experimental curve. The similarity is usually checked by the linear regression coefficient, which however does not provide an immediate clue regarding the goodness of fit. In order to circumvent this problem, another mathematical index was selected, which is terminated the FOM [Pagonis.V; Kitis.G; Furelta.C, 2006] and is defined as
The FOM index value provides a measure for the goodness of fit; the lowest its value, the best fit. Therefore, every fitting attempt should results in minimising the FOM (Pagoniset al., 2006) index value, Which is archieved by changing the set of the parameter values of each glow peak .This is archived by using certain optimisation software packages, the solver, the power full add in of Excel. A full description for the latter is presented in the following section.
Returning to spread sheet preparation procedure, two more columns are required, for instance E and F, in order for The sum of the fitted(calculated) glow peaks and the absolute value of the difference between each experimental and caluculated data point to be respectively presented. The main objective is to minimise the value in column F.finally, showing the FOM index values among the intial cells of the spreadsheet is suggested.

The spreadsheet described as an example for the deconovolution of the glow curve into its two overlapping glow peaks, in order for the parameters associated with the individual peaks to be estimated. Only the first 21 rows are shown for the sake of brevity. Columns(A19:A21) and (B19:B21) contain the experimental data points for the TL glow curve, While columns (C19:C21) and (D19:D21) contains the fitted data points using the GOK model. Row nine holds the value of a multiplier factor that is necessary for further analysis and represents the order of peak height intensity.

The heating rate used throught the measurement is given in cell B2 since it is a common parameter for all the glow peaks. Furthermore, the TL integral of each glow peak (sum of the data in column below row 19) is given in row 11 of the corresponding column, while in row 13, the corresponding frequency factor are shown. The frequency factor values are calculated from the respective equation (1) using the values of E, Tm, and b obtained from the curve fitting and using the heating rate given in cell B2.

3. THERMOLUMINESCENCE GLOW CURVE

The phosphor of $CaSo_4$: Dy has been prepared by acid evaporation method developer by yamashita et al as disussed . The $CaSo_4$: Dy phosphor powder (74 -250µm size) is irradiated by beta irradiated contain the radioactive source ^{90}sr-^{90}y s(30_s). Glow curve for the irradiated samples (-5 mg) are recorded up to 500c for various linear heating rates 5k/s using the Riso. [Yigal S. Horowitz, 1984]

4. RESULTS AND DISCUSSION

The thermoluinescence material $CaSo_4$:Dy used is that of a complex, thermoluminescence glow curve, consisting of three individual peaks using the GOK expressions. In the first step, the temperature in K and normalised thermoluminesence intensity in a.u of the thermoluminescence glow curve of $CaSo_4$: Dy to the columns A and B. In the second, the subsequent columns C,D and E are ascribed to each one of the individual peaks 1,2 and 3 of $CaSo_4$: Dy respectively. The first peaks obtained at temperature 400K with thermouminescence intensity at 0.170079(a.u), the second peak obtained at temperature 500k with thermoluminesence intensity at o.810471(a.u), and the third peak obtained at temp 650K with the thermoluminescence intensity at 0.47758(a.u).and comparing the thermoluminescence material temperature and intensity values.

Using GOK Expressions [6]

$$I(T) = I_m . b^{b/b-1} . \exp\left(\frac{E}{KT} . \frac{T-T_m}{T_m}\right) X \left[(b-1) . (1-\Delta) . \frac{T^2}{T_m^2} X. \exp\left(\frac{E}{KT} . \frac{T-T_m}{T_m}\right) + Z_m\right] e^{-b/b-1} \quad \text{--------------(1)}$$

Where

$$\Delta = \frac{2KT}{E}$$

$$\Delta_m = \frac{2KT_m}{E}$$

$$Z_m = 1 + (b-1) . \Delta_m$$

We found the peak values by using thermoluminesencedatas Imax, Tmax, E(ev) and B .For this purpose, We should insert intial, arbitrary but meaningful values for the parameters Im,Tm, E and b.For each single glow peak and these values are for the fitting thermoluminescence, We should add the columns C,D and E values Which will be in the column 'F'. And in column G, in experimental thermoluminesence values substracts the fitting thermoluminesence values .And in column H the 'SUM' should be calculated.

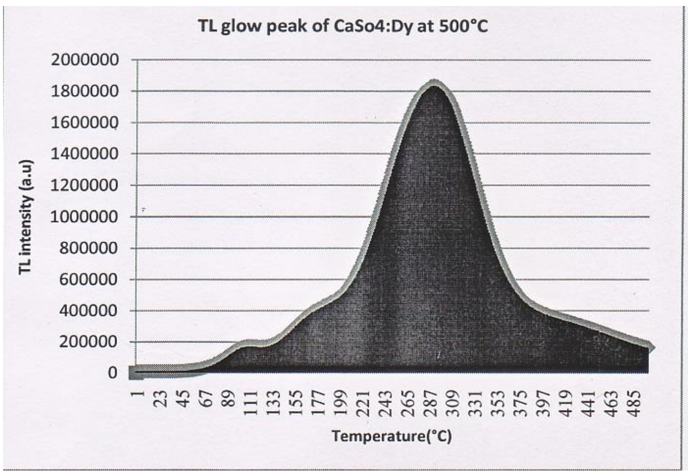

Fig. 1 Thermoluminescence Glow peak curve of $CaSo_4$: Dy at 500°c in a heating rate of 5°c/s

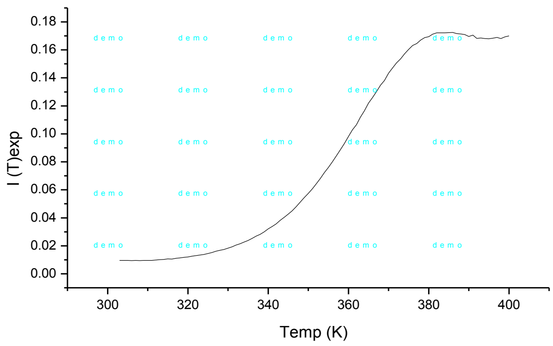

Fig. 2 Graph between temperature (303-400K) and experimental thermoluminescencevalueI(T)

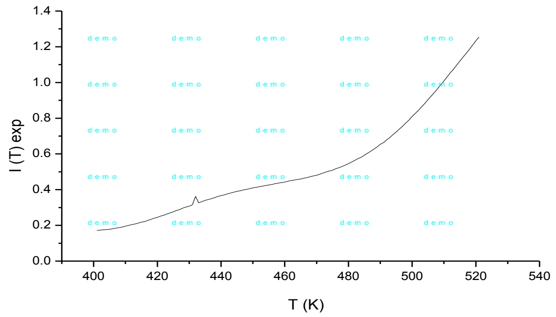

Fig. 3 Graph between temperature(401K-521K) and experimental thermoluminescencevalueI(T)

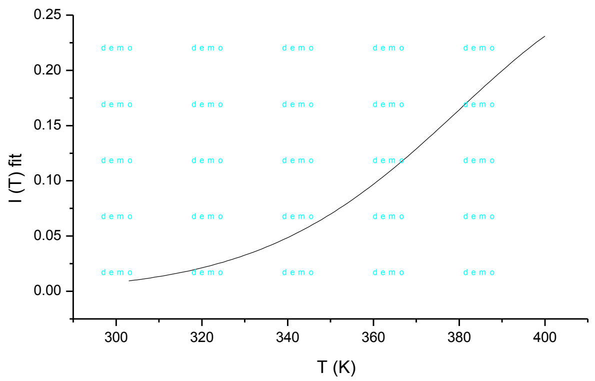

Fig.4 Graph between temperature(303K-400K) and fitting thermoluminescencevalueI(T)

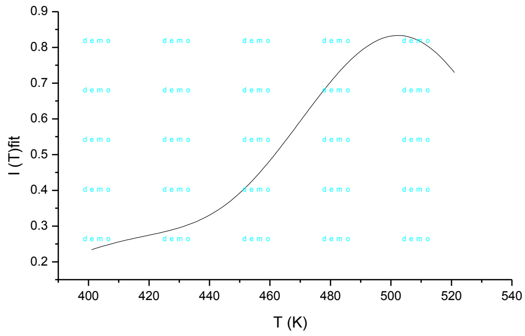

Fig.5. Graph between temperature (401K-521K) and fitting thermoluminescencevalueI(T)

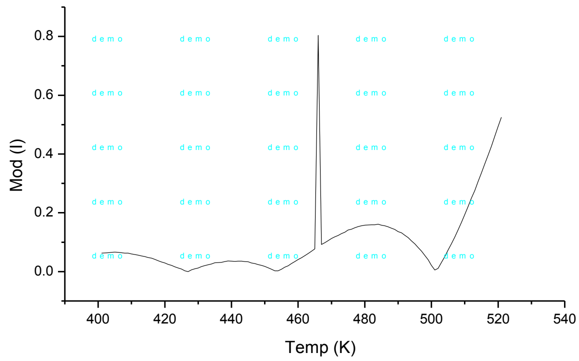

Fig. 6.Graph between temperature and MOD

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