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Synthesis of Nanocrystalline Al_2O_3 for Study of Thermoluminescence Characteristics

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ABSTRACT

Nanocrytstalline Al_2O_3 Phosphor has been synthesized by the chemical Method. Annealed at different different Temperature (800, 1000, 1200, 1400 1600 º C) the synthesized sample is annealed at high temperature of 1600 º C. Phase change from α- Al_2O_3 : C To γ- Al_2O_3 : C is Observed due to annealing. These nanocrytstalline sample were irradiated with gamma radiation their Thermoluminescence, characteristic have been studied. The TL glow curve is the single peak at 185 C and Large increase in TL and OSC Sensitivity. TL responses have been studied with the gamma radiation. For dose varying from 100Gy.The XRD of Al_2O_3 Phosphor Annealed At 800 º C and SEM Al_2O_3 Phosphor annealed at 1200 º C, Thermoluminescence Glow Curves of Al_2O_3 Phosphor Annealed at Different Temperature.

Keywords: *Nanocrytstalline, Thermoluminescence, Characteristics.*

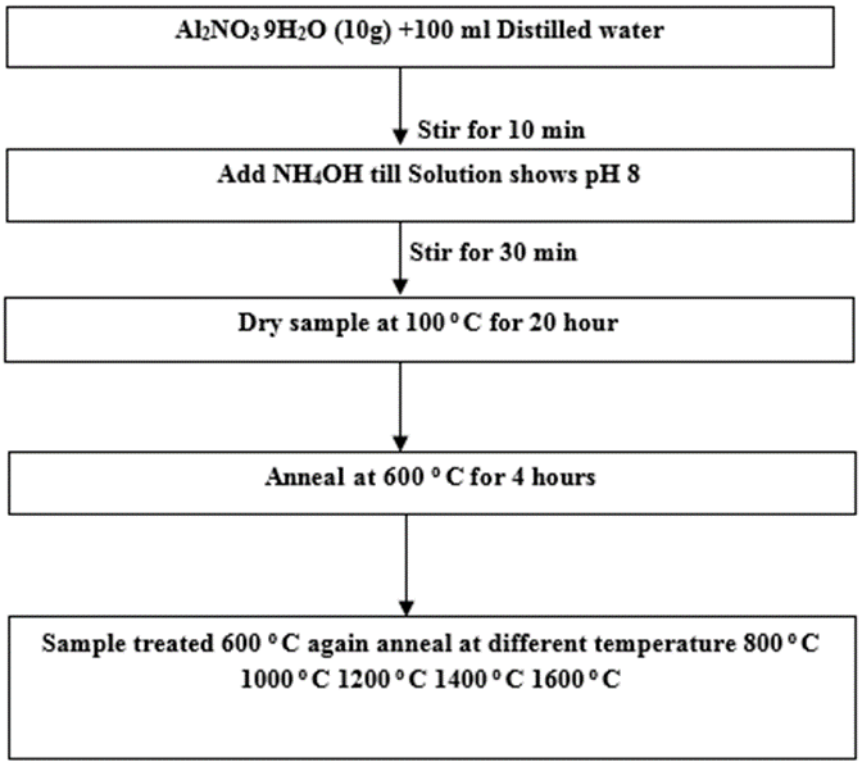
1. INTRODUCTION

Thermolumunescence is technique which is widely studied in the field of fundamental research to understand the mechanism of occurrence of thermally stimulated emission. Many researchers have suggested TL mechanism for pure and impurity activated material. TL techniques have been found to be highly successful in dating ancient pottery samples. It gives exact date of kiln firings of the sample. TL can offer an attractive technique in selected materials that are commonly encounter in criminal cases and reduces probability of any coincidental matching and improve the confidence of TL measurement.

1.1 EXPERIMENTAL PROCEDURES

10 gm of aluminium nitrate [$Al(NO_3)_3 9H_2O$]was dissolved in 100 ml distilled water and stirred for 10 min.

- Ammonium Hydroxite [NH_4OH] was added drowse in above solution till it shows PH8, then it was stirred up to 30 min.
- Then solution was filtered and dried at 100 C for20 hrs.
- Then powder was annealed at 600 º C for 4hrs in air.
- Then sample treated at 600 º C again annealed at 800, 100, 1200, 1400 and 1600 º C for 4 hrs in air.



2. RESULTS AND DISCUSSION

To confirm the formation of the compound and nanoparticles, X-ray diffraction pattern was studied at room temperature by using Cu-target (Cu-k 1.54 º A) on Bruker AXS D8 advance x ray diffractometer and matching with the standard data available (JCPDS card No 29-0063). The XRD spectrum shown in chart 1.which exhibit cubic structure (ϒ- phase of alumina). The average particle size of nanoparticles is estimated from the line broadening of the XRD peaks assuming the particle are stress free and therefore, the size can be estimated from a single diffraction peak using Scherrer's formula.

$d = 0.9\lambda / \beta \cos(\theta)$

Where,

D is the average grain size of the crystallites,

λ is the incident wavelength,

θ is Bragg's angle,

β is the diffracted full width at half maximum (radian) caused by the crystallites.

The average grain size of the concentrated phosphor is estimated to be 10 nm which confirms its nanocrystalline form

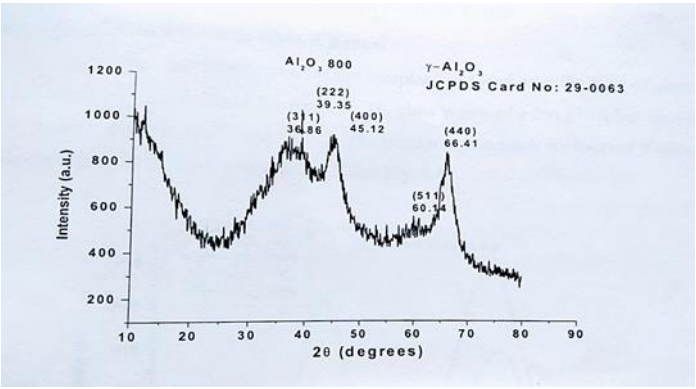


Chart. 1 XRD of Al_2O_3 annealed at 800º C

2.1 SEM of Al_2O_3:

The shape and size of the particle is also determined by the SEM. The SEM photograph of Al_2O_3 is as shown in the chart. 2 which shows that the particles are in the form of nano sheets.

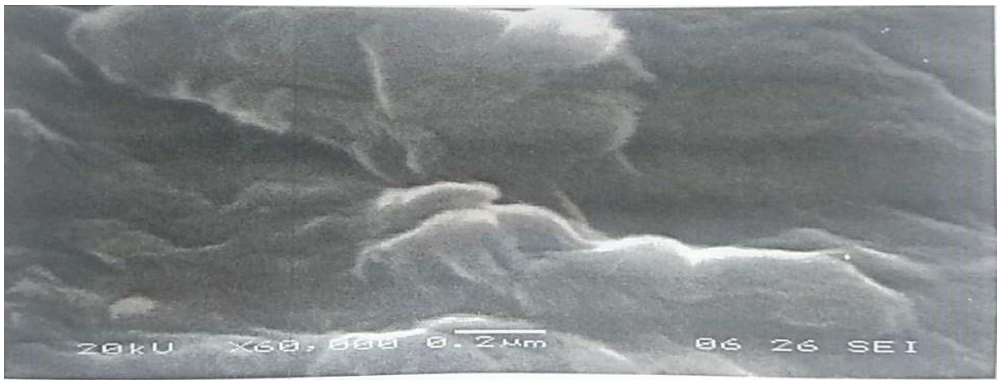


Chart. 2 SEM of Al_2O_3 annealed at 1200°

2.2 Thermolumunescence Glow Curves:

Chart.3 shows that the TL responce of the samples irradiated at 1kGy dose of gamma radiation using 60 Co Gamma source. The TL glow curve of nano phosphor shows a two peaks at around 200° C and 410° C. The maximum intensity is observed if sample annealed at 1200°C as shown in Chart.3 and Chart.4

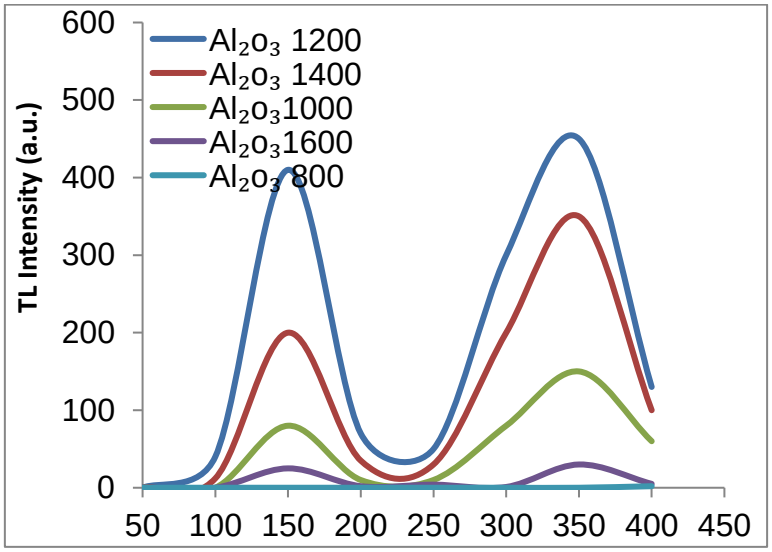


Chart.3 Thermolumunescence Glow curves of Al_2O_3 annealed at different temperatures.

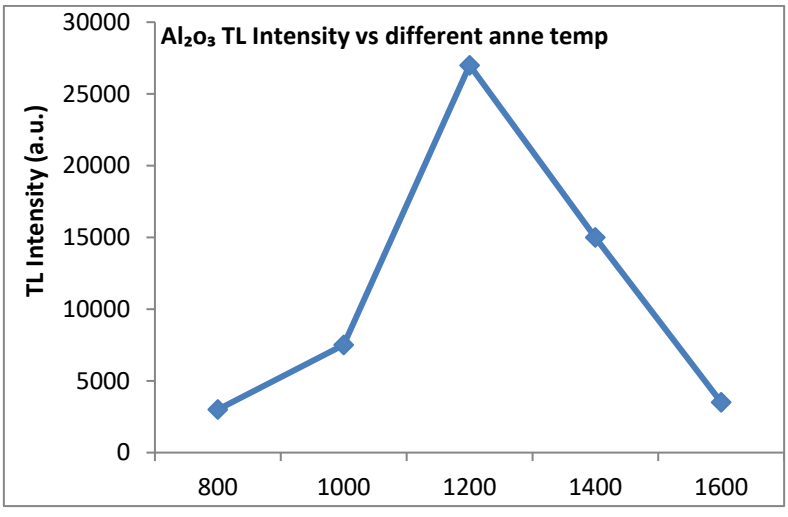


Chart. 4 Thermoluminescence Intensity vs annealing temperature of Al_2O_3

3. CONCLUSION

The Al_2O_3 nanophosphor synthesiszed by chemical method. It exhibit gamma phase if annealed at 800ºC. The SEM shows nanosheets of Al_2O_3. The TL glow cure structure doses not change on annealing. The TL intensity is maximum if sample is annealed at 1200ºC. So sample annealed 1200 ºC can be used for further dosimetric purposes. Simple glow curve structures, easy method of synthesis, linear dose response make the nanocrystalline Al_2O_3 phosphor a good candidate for radiation dosimetry. Especially, the higher dose range is very important for certain application such as radiation therapy for cancer patients and food preservation.

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