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Thermoluminescence Study of Mineral Ivory Soda

K. Ankama Rao[1], S.V.R.S.K. Ravi Kumar[2], N.V.P.Rao[1], K.V.R. Murthy[3]

[1]Department of Physics, VSR & NVR College, Tenali, India
[2]Department of Physics, Hindu College, Guntur, India
[3]Display Materials Laboratory, Applied Physics Department, Faulty of Technology and Engineering, M.S. University of Baroda, Baroda, India

Abstract— *The present paper reports the thermoluminescence characteristics of Ivory Soda mineral collected from Bhor Ghats near Sangamalner, Nasik Distric, Maharasta. The TL of as received minerals at varies heat treatment was recorded and also 15Gy beta dose was given to each sample prior to TL recording. TL of as received specimen (NTL) annealed for 1 hour and quenched from 200, 400, 600 and 800ºC. The Ivory Soda mineral displayed a well resolved sharp peak around 140ºC and 145ºC for AQ from 600 and 800ºC. XRD and TGA of Ivory Soda mineral were reported.*

Keywords— Ivory Soda, thermoluminescence; minerals, NTL, TGA, XRD, etc.

I. INTRODUCTION

Geology is the earliest disciplines to accept the TL technique in dating of mineralization, igneous activities, sedimentation and evaluation of growth rate of beaches and sand dunes. The TL technique is useful in dating of geological specimens where all conventional methods fail. TL can provide a perfect passive measurement i.e. integrated irradiation levels over extended periods of the order of three years. In a geological specimen, the TL would starts building up from the time of its crystallization and normally continues throughout its existence due to the radioactivity present in the minerals and in the surrounding materials, till it saturates.

The extreme sensitivity of TSL for detecting the presence of defects, as few as 10^9 within a specimen is beneficial for detecting low radiation levels which are encountered in personal and environmental monitoring.

The present paper reports the thermo luminescence characteristics of transparent China Clay mineral collected from Morbi, Rajkot, Gujarat, India. The TL was recorded for Ivory Soda mineral as received (AR), annealed and quenched (AQ) from 200, 400,600 and 800ºC followed by 15Gy beta dose given to each 5mg weighed sample from Sr-90 beta source.

II. EXPERIMENTAL METHOD

The as-received mineral China Clay was weighed carefully by using Citizen Model electronic weighing balance. Grinded thoroughly about ~1 hour using a mortar and pestle in order to get a powder size of 60 micron and TL was recorded by giving varies heat treatment.

In the present paper the TL set-up manufactured by Nucleonix Systems, Hyderabad was used [3-9]. The reproducibility of the system was found within 3% [1-2].

III. RESULTS & DISCUSSION

In Fig 1 curve-1 is the TL of 25 Gy beta irradiated as received Ivory Soda. It shows a humpy peak around 320ºC with TL intensity 44au. Curve -2 is the TL of 25 Gy beta irradiated Ivory Soda annealed and quenched from 200ºC. It displays a broad humpy peak around 248ºC with more than 50% less intensity when compared to curve-1. Curve-3 is the TL of 25 Gy beta irradiated Ivory Soda annealed and quenched from 400ºC. It is observed from curve-3, a sharp well resolved peak at 135ºC followed by humps with little high intensity when compared to curve-2. Curve- 4 is the TL of 25 Gy beta irradiated Ivory Soda annealed and quenched from 600ºC. It shows a sharp well resolved peak around 140ºC followed by humps with little less intensity when compared to curve-3. Curve 5 is the TL of 25 Gy beta irradiated Ivory Soda annealed and quenched from 800ºC. It displays a well resolved peak around 145ºC followed by a broad peak around 270ºC with nearly equal intensities. From the figure it is also observed that as the annealing temperature increases from 200 to 800ºC entire TL pattern changes and finally resolved as two peaks with slight variation in intensity. Table-1 shows the TL peak temperatures and the corresponding TL peak intensities of Ivory Soda as received, annealed and quenched from 200,400, 600 and 800ºC temperatures**.**

Fig.2 is the XRD pattern of Ivory Soda, it is clearly observed that the maximum peak obtained at 35.5º.

Fig.3 A & B are the particle size histograms of as received Ivory Soda and annealed and quenched from 800ºC Ivory Soda.

Fig. 4 is the TGA of Ivory Soda. From figure it is found that there are phase changes around the temperatures of 312ºC and 543ºC.

Fig. 5 is the FTIR pattern of Ivory Soda for as received (AR), annealed and quenched from 800ºC samples.

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From the FTIR study of as received Ivory Soda the band around 3622 is assigned to Al-O-H inter octahedral stretching, this may be due to the structural water of the mineral.

The FTIR study of Ivory Soda annealed and quenched from 800ºC follows the same pattern as AR sample except reduction in transmittance. This may be due to partial collapse of the structure when the mineral is subjected to 800ºC. Table-2 is the FTIR Spectra of As received and annealed and quenched from 800ºC Ivory Soda.

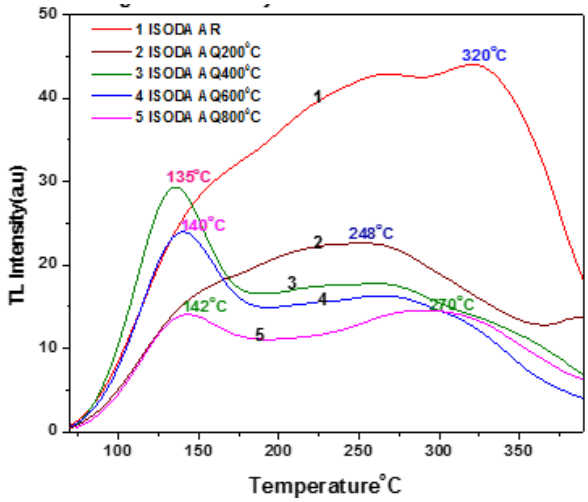

Fig.1: TL of IVORY Soda-Beta Irradiation

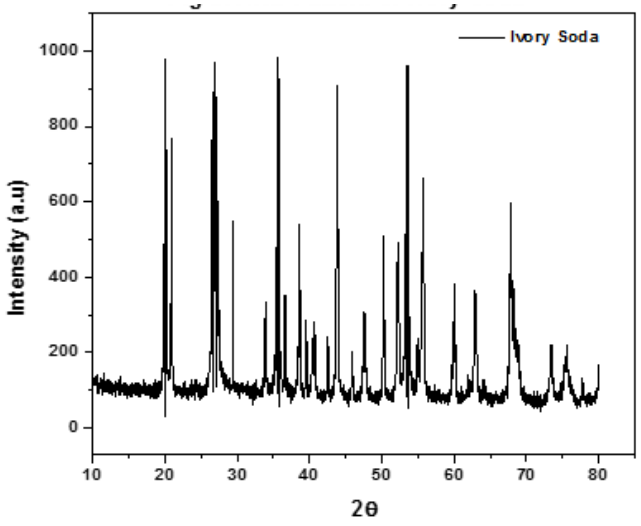

Fig.2: XRD Pattern of IVORY Soda

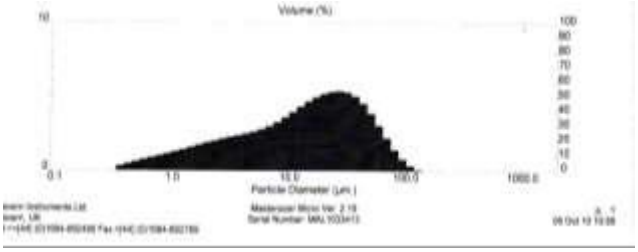

Fig.3A: Particle size histogram of as received (AR) Ivory Soda

Fig.3B: Particle size histogram of annealed & quenched (AQ) 800ºC Ivory Soda

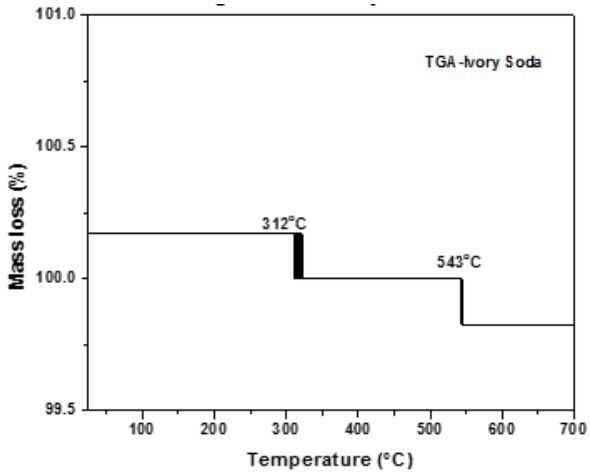

Fig.4: TGA of Ivory Soda

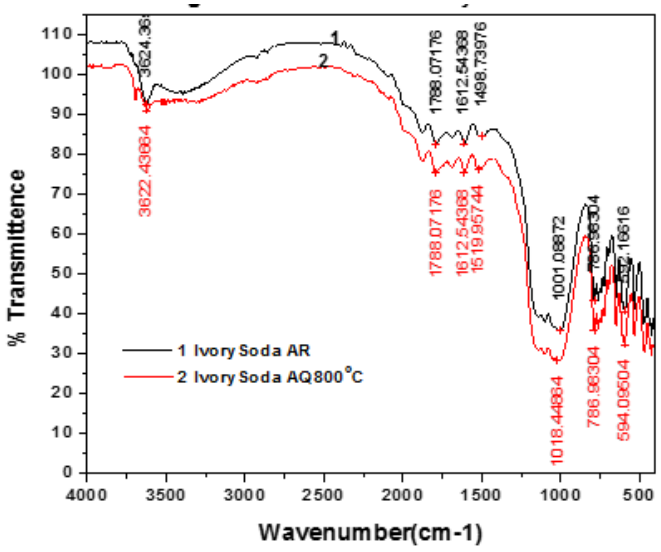

Fig5: FTIR Pattern of IVORY Soda

Table.1: TL of Ivory Soda -Beta Irradiation

S.No	*Treatment*	*TL Peak Temperature (ºC)*	*TL Peak Intensity (a.u)*
1	*AR*	*320*	*44*
2	*200ºC*	*248*	*22.6*
3	*400ºC*	*135*	*29.4*
4	*600ºC*	*140*	*24.0*
5	*800ºC*	*145, 270*	*13.7, 14.5*

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IV. CONCLUSIONS

1. From TL Study of Ivory Soda It is found that as the annealing temperature increases from 200 to 800ºC entire TL pattern changes and finally resolved as two peaks with slight variation in intensity. This may be due to various phase changes occurred while annealing the mineral from 200-800ºC temperatures.
2. From XRD of Ivory Soda the Crystallite size of Ivory Soda is calculated using Scherrer's formula and is found around 87.15 nm.
3. From the result obtained from the laser diffraction particle size analyzer, the average particle diameter of as received Ivory Soda mineral is **21.64 µm**, and that of annealed and quenched(AQ) from 800ºC Ivory Soda mineral is **23.17 µm**.
4. From TGA of Ivory Soda there is a constant phase changes observed in the temperature region312ºC and 543ºC.

Table.2: FTIR Spectra of Ivory Soda

Annealed & quenched from 800ºC			**As received Sample**		
Band (Cm^{-1})	Transmittence (%)	Assignments	Band (Cm^{-1})	Transmittence (%)	Assignments
3622.5	91	Al-O-H (inter-octahedral)	3624.3	92	Al-O-H (inter-octahedral)
1788	79	---------	1788	87	----------
1612.5	79	H-O-H Stretching	1612.5	88	H-O-H Stretching
1519.9	78	Aromatic Nitrate	1498.7	89	C-H Stretching
1018.4	27	Si-O-Si, Si-O Stretching	1001	38	Si-O-Si, Si-O Stretching
786.9	35	Si-O Stretching Si-O-Al Stretching (Al,Mg)---O-H, Si-O---(Mg,Al) Stretching	786.9	45	Si-O Stretching Si-O-Al Stretching (Al,Mg)---O-H, Si-O---(Mg,Al) Stretching
594	30	Si-O Stretching Si-O-Al Stretching	592.1	40	Si-O Stretching Si-O-Al Stretching

5. From FTIR study of Ivory Soda it is observed that the absorbing band around 1018 is due to Si-O-Si and Si-O stretching, since majority of the component in the mineral is SiO_2 and Al_2O_3. The absorption band around 786 is mostly due to Si-O-Al stretching.

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