ISSN : 0974 - 7486 Volume 7 Issue 5

Trade Science Inc.

Materials Science

An Indian Journal

Full Paper

MSAIJ, 7(5), 2011 [335-340]

Thermoluminescence study of based materials of ceramic tiles

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Received: 20th June, 2011 ; Accepted: 20th July, 2011

ABSTRACT

Many flooring materials most of them are in natural form are used to manufacture floor tiles for household flooring purpose. The peoples demand for variety of flooring material Leeds to develop various types of ceramic tiles. In India ceramic industry is fast growing one, more then 400 units of manufacturing ceramic tiles, vitrified tiles and sanitary ware, situated around Morbi, Rajkot, Gujarat, India. Many natural minerals are used as the raw materials required for the manufacturing ceramic ware. The following minerals are used to manufacturing the ceramic tiles i.e. Quartz, Feldspar, Zircon, Talc, Grog, Alumina oxide, etc. Most of the minerals are from Indian mines of Gujarat and Rajasthan states, some of are imported from Russian sub continent. The present paper reports the thermoluminescence characteristics of Feldspar, Alumina and Quartz minerals collected from the ceramic tiles manufacturing unit, Morbi. The as received minerals TL was recorded (NTL), and annealed and quenched from 500°C and 900°C followed by 15Gy beta dose given from Sr-90 beta source TL was recorded and the comparative TL (Thermoluminescencs) study of above materials are presented and it represent some special characteristics of the materials. The TGA and X - rd of such materials are also given for batter understanding.

KEYWORDS

Natural thermoluminescence (NTL); Thermoluminescence (TL).

INTRODUCTION

Many natural mineral are used to manufacture floor tiles for household floorings. The demand of a variety of flooring materials has lead to develop various types of ceramic tiles. In India the ceramic industry is one of the fastest growing industries, more then 200 manufacturing units of ceramic tiles, vitrified tiles and sanitary wares are situated at Morbi (Rajkot District, Gujarat state, India). Many natural minerals are used as the raw materials for the manufacturing ceramic wares. The minerals used in manufacturing the ceramic tiles are Quartz, Feldspar, Zircon, Talc, Frit-O, Frit-T, Aluminium oxide, Sodium trypoly phosphate China clay, Bikaner clay, etc. Most of the minerals are from mines in Gujarat and few are from Rajasthan state and imported from Russia. The phenomenon of TL has been studied by many investigators. The thermoluminescence (TL) study in geology, particularly for natural minerals, is an important research tool. The TL study of minerals commonly

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used in ceramic tiles industry, such as feldspar and Zircon gives better understanding about their properties. The systematic study of TL of such minerals is helpful to solve the basic raw materials quality problem the ceramic tiles industries.

EXPERIMENTAL METHOD

Strontium-90	
General	
Name, symbol	Strontium-90, ^{90}Sr
Neutrons	52
Protons	38
Nuclide data	
Half-life	28.8 years
Decay products	^{90}Y
Decay mode	**Decay energy**
Beta decay	0.546 MeV

The natural minerals used in manufacturing ceramic tiles are collected from the industry. Most of the materials used for the TL analysis were indigenous ones and a few were imported minerals. TL of these minerals was recorded using TL set-up supplied by Nucleonix Systems, Hyderabad[1]. Irradiation was carried using Sr-90 beta source. Equal quantities of samples (5 mg) were used for the analysis.

RESULTS AND DISCUSSION

Figure 1.1 is the TL of 5mg of weighed powder was taken to record TL glow curve of Quartz (NTL) without any pre heat treatment and irradiation. The glow curve exhibit one hump like glow peak at temperature at 332^{0}C. There is no good TL is observed.

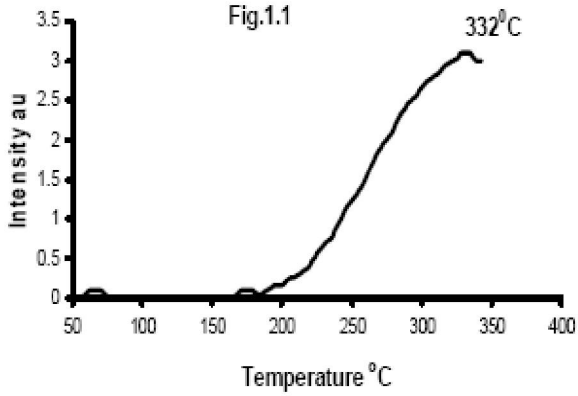


Figure 1.2 shows TL glow curve of Quartz irradiated with beta dose of 15 Gy using Sr^{90}. Here one peak occurs at temperature 110^{0}Cand intensity of 1.83au here little TL is recorded. It is noted that after irradiation one trap developed and released carrier during the TL measurement.

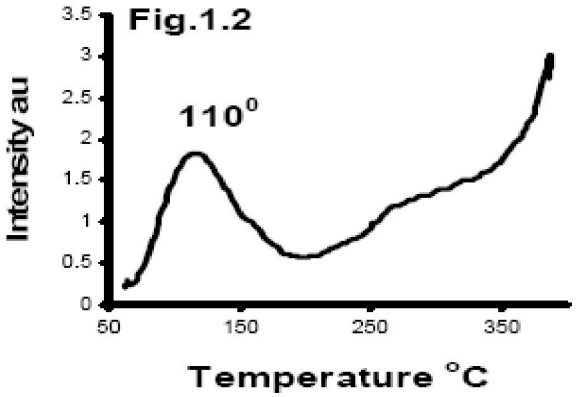


Figure 1.4 is the TL glow curve of Quartz annealed and quenched from 500^{0}C and given a beta dose of 15 Gy using Sr-9o beta source. TL glow curve of 400^{o}C AQ sample of Quartz exhibits one well resolved and isolated TL peak with high intensity around 100^{o}C. This peak is interesting TL peak in dosimetric point of view.

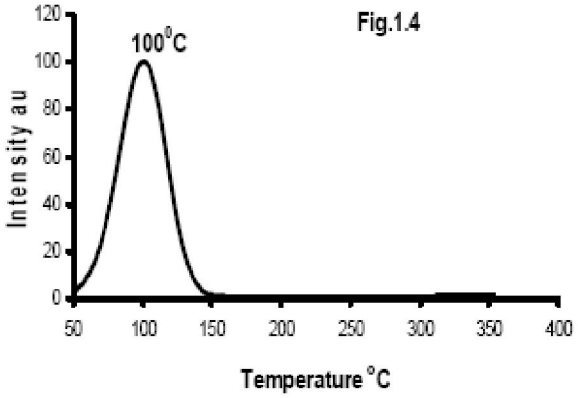


Figure 1.6 is the TL glow curve of Quartz annealed and quenched from 900^{0}C and given a beta dose of 15 Gy using Sr-9o beta source. TL glow curve of 900^{o}C AQ sample of Quartz exhibits one well resolved and isolated TL peak with high intensity around 102^{o}C along with a hump around 210^{o}C.

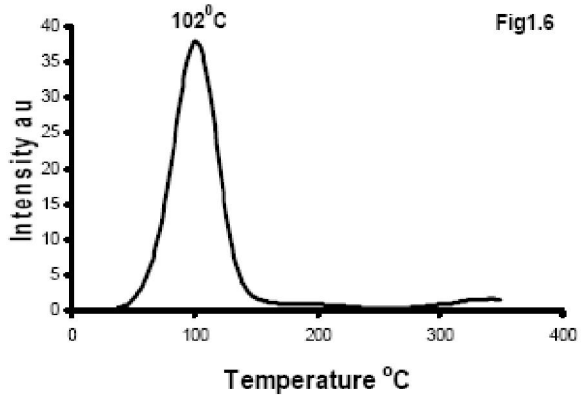


Figure 2.1 shows the TL glow curve of Feldspar mineral with out any pre heat treatment and irradiation. The glow curve exhibits one well resolved peak at 308^{0}C temperature, here heating rate is 4^{O}c/sec for TL measurement the intensity of peak is 76au noted this intensity is remarkable this sample gives TL without any pre heat treatment this result is interesting here phase changed thrmoluminescence is occurs. Some mineral contain water molecule due to this result the phase change TL produced . Here till temperature 170^{0}C the intensity remain near to zero but then after intensity continuously increasing with temperature. From this result it is noted that one trap with large numbers of carriers generated with peak 308^{0}C.

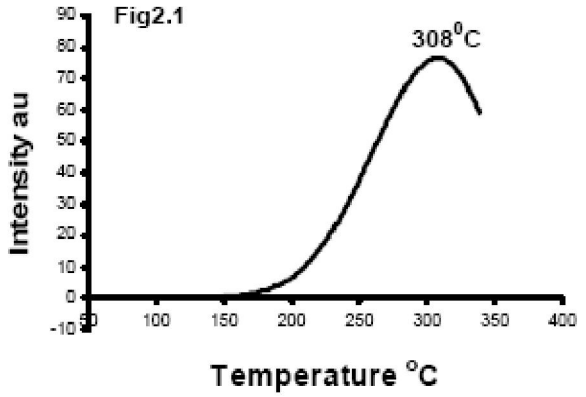


Figure 2.2 shows the TL glow curve of Feldspar mineral irradiated with beta dose of 15 Gy by Sr^{90}here no any pre heat treatment is given to the sample, here two well resolved glow peak occurs at temperature 141^{0}C and 312^{0}C it is indicate that two traps with large carriers is related with this temperature range here the intensity of peak is 43au and 39au respectively, here it is noted that the intensity of peak 309^{0}C in figure 2.1 is decreased in figure 2.2 and the peak temperature slightly change from 309^{0}C to 312^{0}C it shows fading effect but one remarkable result is that one new peak occurs at temperature 141^{0}C with intensity 43au this peak is well resolved and stable so it is considered as dosimetric peak.

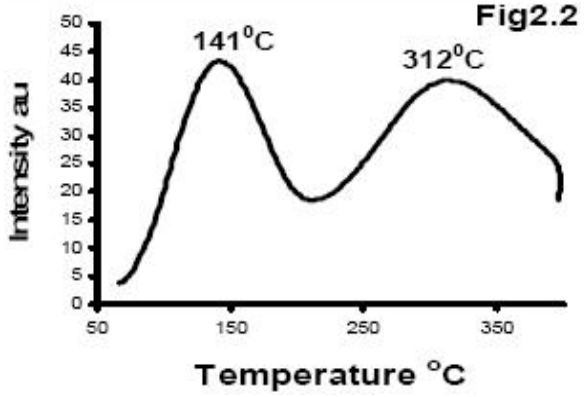


Figure 2.4 shows the TL glow curve of Feldspar mineral with pre heated at annealing and quenching temperature at 500^{0}C and irradiated with beta radiation dose of 15Gy by Sr ^{90}, here heating rate is 4^{O}c/s for TL measurement, here one well resolved glow peak occurs at temperature 123^{0}C and peak intensity of 39au is recorded.

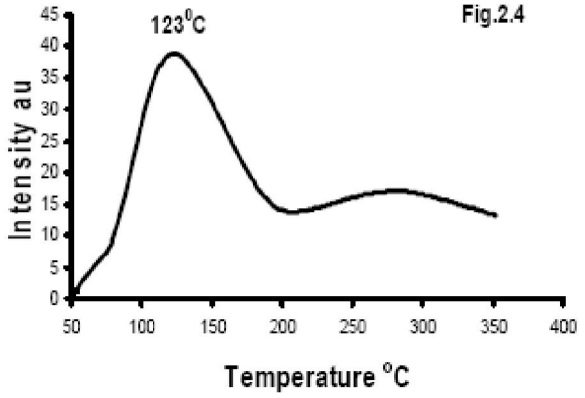
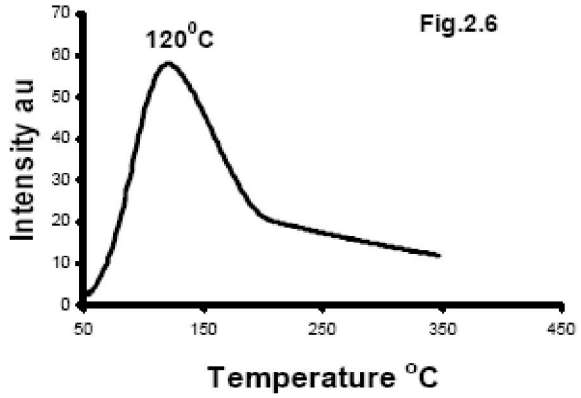


Figure 2.6 shows the TL glow curve of Feldspar mineral with pre heated at annealing and quenching temperature at 900^{0}C and irradiated with beta radiation dose of 15 Gy by Sr ^{90}, here heating rate is 4^{O}c/s for TL measurement, here one well resolved glow peak occurs at temperature 120^{0}C and peak intensity of 58au is recorded

Figure 4.1 shows TL glow curve of Alumina with



out treatment of heat and irradiation dose. This glow curve exhibits one peak at temperature 159°C and intensity of 0.11au here no significant TL is recorded, the material exhibits low TL sensitivity in natural form.

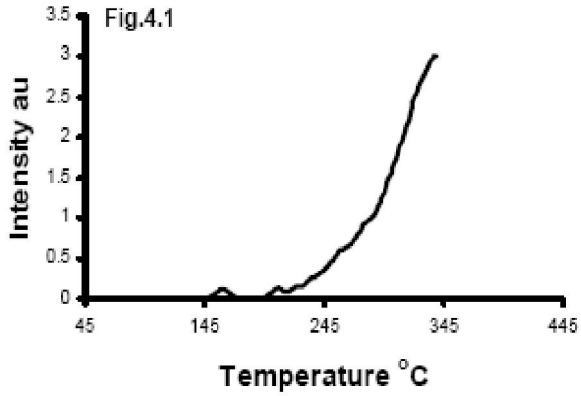


Figure 4.2 shows TL glow curve of Alumina with irradiated with beta dose of 15 Gy by Sr^{90}. The glow curve exhibits one peak at temperature 257°C and with intensity of 34au, here it is noted that after irradiation the intensity of TL is increased it is means that that large carriers oriented trap is generated.

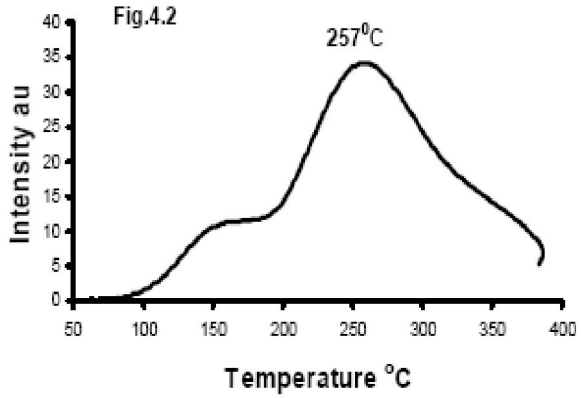


Figure 4.4 shows the glow curve of Alumina treated with annealing and quenching temperature of 500°C and irradiated with beta source of 15 Gy. Here glow curve exhibits one well resolved peak at temperature 275°C and intensity of 48au also one broad hump is developed.

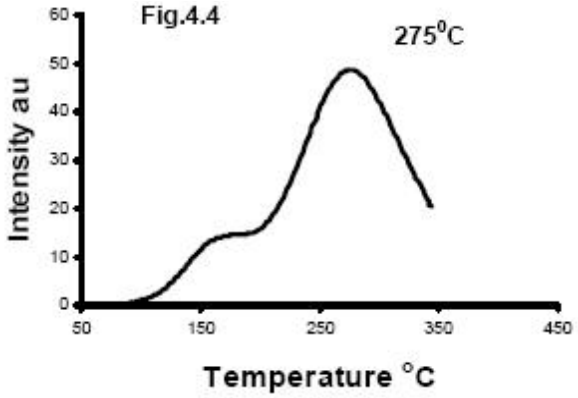


Figure 4.6 shows the glow curve of Alumina treated with annealing and quenching temperature of 900°C and irradiated with beta source of 15 Gy The heating rate for TL is 4°c/s. here glow curve exhibits one well resolved peak at temperature 275°C and intensity of 69au also one broad hump is developed.

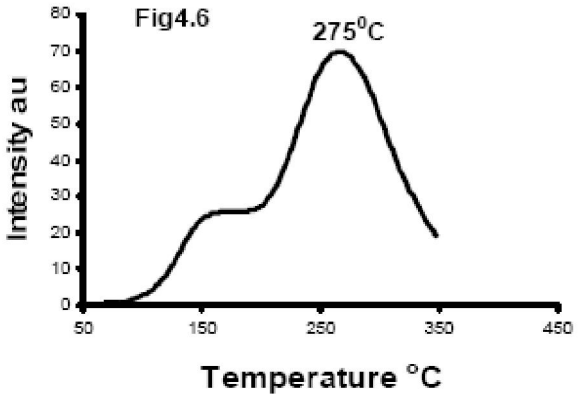


Figure 1.10 shows the TGA of Quartz from the TGA it is clear that variation seen in phase between temperature range 400°C and 800°C. The TL intensity is decreased between this temperature ranges due to

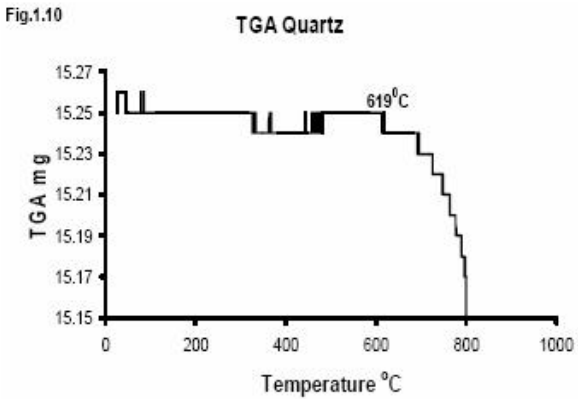


Fig.1.11

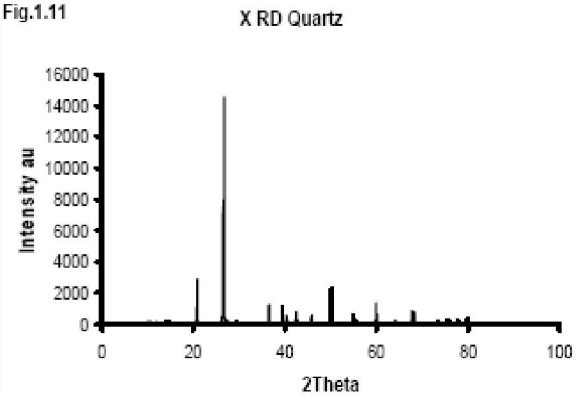


Fig.2.9

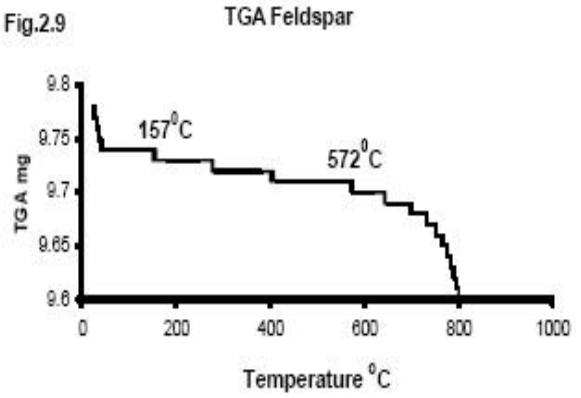
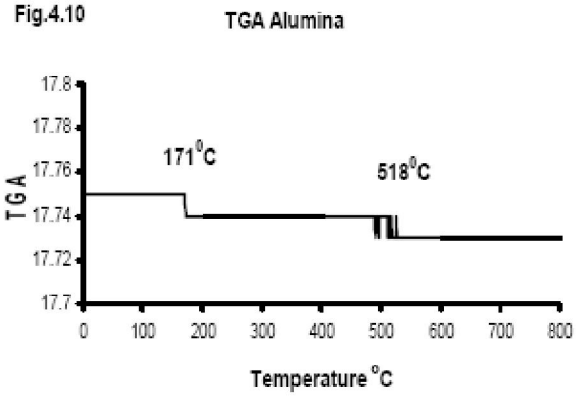


Fig.4.10



CONCLUSION

- The natural TL [NTL] observed in Above minerals under study as well as NTL+ATL followed by the TL observed from annealed and quenched form 400°C and 800°C followed by beta irritation leads to the conclusions the results are due to the traps formed by irradiation as well as heat treatment to the subjected mineral.
- The systemic study may be more useful in checking the purity of the raw materials which in turn leads to improving the quality of ceramic tiles in ceramic industries. Further studies are in progress.

phase change.

Figure 1.11 shows the X RD pattern of Quartz it is clearly matches with the standard peaks observed at 26.66, 20.88, 50.18 and 60 ° are major peaks of standard quartz sample.

Figure 4.11 shows the X RD pattern of Alumina it is clearly matches with the standard peaks observed at 25.72, 35.28, and 57.62 ° are major peaks of standard Alumina sample.

Fig.2.10

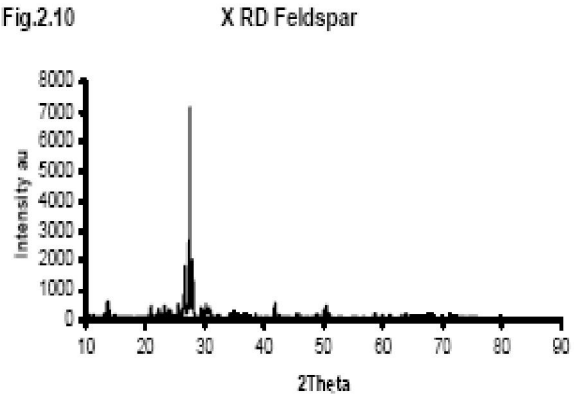
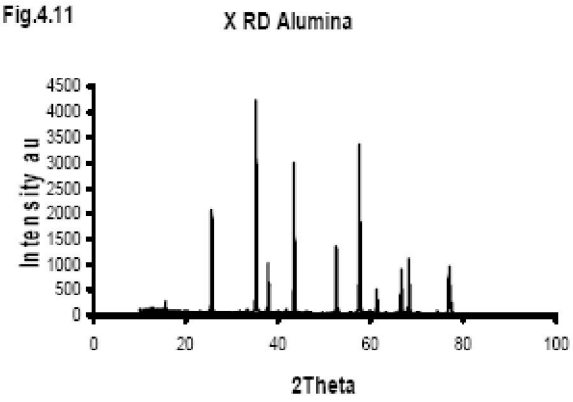


Fig.4.11



ACKNOWLEDGEMENT

The author (H.C.Mandavia) is thankful to U.G.C., New Delhi, for the awarded of Teacher Fellowship and thankful to Shri C.M.Shanghavi (Hons. Secretary Sarvodaya Education Society), Shri S.M.Vadia (Executive Secretary Sarvodaya Education Society) and Dr. P. K. Patel (Principal Shri M. M. Science College, Morbi) to promote this research.

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