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Study of 210°C thermoluminescence peak followed by optical stimulation in synthetic quartz

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Abstract

The quartz material exhibits number of thermoluminescence glow peaks under different physical treatments to the material. The behavior of 210°C TL has studied after post irradiation heat treatment followed by optical stimulation at elevated temperature. The results are compared with the TL glow curves prior to stimulation. It is noticed that such peak grows in higher annealed sample followed by radiation and remains stable even though material pre-heat to 290°C followed by radiation. It suggested the predominant growth of Ge center during thermal treatment.

Keywords: annealing treatment, dose, pre-heat treatment, OSL TL,

1. INTRODUCTION

The quartz material has variety of thermoluminescence (TL) glow peaks like 110°C, 180°C, 210°C 245°C 280°C, 325°C and 375°C. The growth and contribution of these peaks depend upon the environment and history of the samples **[1]**. Researchers have studied the TL peak position under the influence of different physical treatment such as annealing treatment, dose, and illumination condition **[2-3]**. They have reported that several peaks are well stable and sensitized with respect of physical treatments. It is suggested to TL dosimetric application of quartz also.

The aim of the present paper is to resolve the behavior of TL peak under optical stimulation at elevated temperature followed by post irradiation heat treatment (PIHT). The results are compared with the TL glow curves prior to optical stimulation. It is observed that a significant peak at 220°C is quite stable and highly sensitive to the annealing treatment followed by the radiation. It is attributed the noticeable growth of Ge center in presence of identical physical conditions.

2. EXPERIMENTAL DETAILS

Sample:

- Synthetic Quartz Crystal **[4]**
- Grains: 0.063-0.053mm

Protocols

- Un-annealed sample + 5.04Gy beta dose + TL at RT (25°C).
- AQ at 600°C and 1000°C, 1hr + 5.04Gy beta dose + TL at RT (25°C).
- AQ at 400°C, 600°C and 1000°C, 1hr + 2.52-302.4Gy beta dose + pre-heat at 290°C for 10sec + OSL at 160°C + TL at RT.

Instruments:

- Mortar and pestle for grinding the sample
- Muffle Furnace for annealing treatment (1200°C ± 1°C accuracy).
- Beta (Sr90) Irradiation source (dose rate of 0.084Gy/sec).
- RISO (TL/OSL-DA-15) TL/OSL Reader; 470nm wavelength for stimulation.

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3. RESULTS AND DISCUSSION

To understand the comparison between implemented protocols for the behavior of the 220°C TL peak, it is necessary to record the thermoluminescence glow curves near room temperature. The glow curves are recorded without optical stimulation.

The sample, annealed at 1000°C for 1hour duration followed by 5.04Gy beta dose, is highly sensitized compared to un-annealed and 600°C annealed sample. Significant enhancement in TL signals to the order of 10^6 counts is observed. It also helped to grow new stable TL peak near 220°C. These results are not observed in the 600°C treated samples of identical dose and annealing duration **[Fig.1]**.

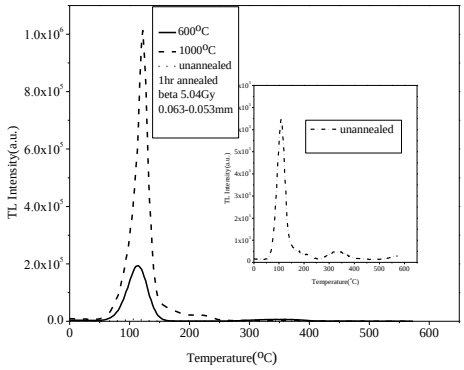

Fig.1 TL glow curve measured at room temperature for annealed and un-annealed samples

In order to present work, the TL glow curves are recorded near room temperature followed by post irradiation heat treatment at 290°C for 10sec prior to optical stimulation at 160°C. The 400°C and 600°C annealed samples exhibit the remarkable growth of 375°C TL **[Fig.2-3]**.

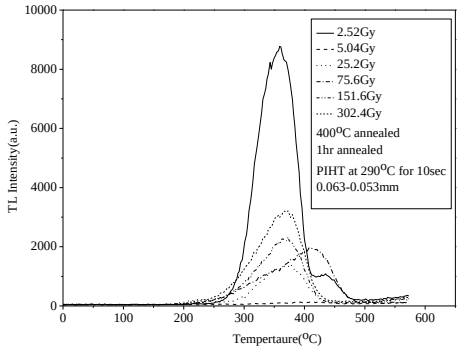

Fig.2 TL measured at room temperature followed by PIHT to 400°C annealed sample.

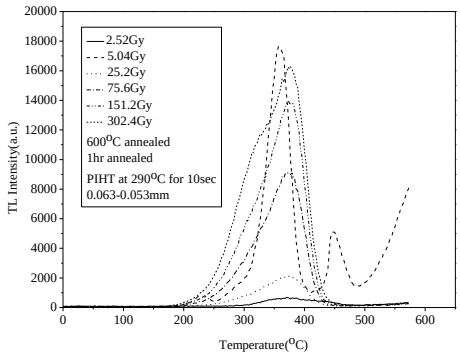

Fig.3 TL measured at room temperature followed by PIHT to 600°C annealed sample.

But the noticeable development of new 220°C TL peak including 375°C TL peak is observed in 1000°C annealed sample followed identical physical conditions to the material **[Fig.4]**.

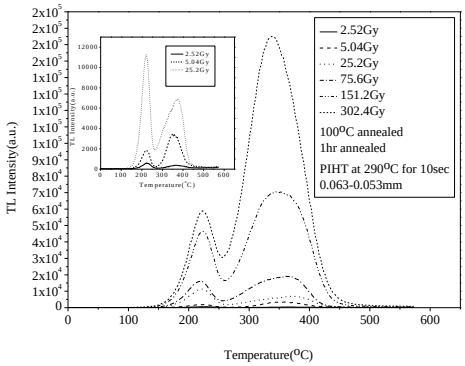

Fig.4 TL measured at room temperature followed by PIHT to 1000°C annealed sample.

The dose response curve is also recorded to thermally stable peak at 220°C TL peak for each exposure [**Fig.5]**.

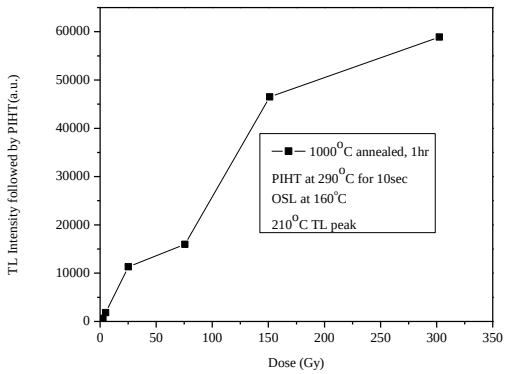

Fig.5 Dose response curve for 210°C TL peak followed by PIHT to 1000°C annealed sample.

Researchers have reported that the 210°C and 375°C TL peaks are well stable peaks in quartz and their family **[5-7]**. They have studied the thermal stability, peak position and dose response for respective application but not much studied under the influence of optical stimulation protocols. The implemented protocol, especially thermal treatment, may be responsible to generate Ge centers corresponding 210°C TL peak rather than 375°C TL peak. It is confirmed by recording the ESR near room temperature for higher annealed sample (1000°C).

4. CONCLUSION

The 1000°C annealed treatment is more predominant to generate new Ge centers corresponding to 210°C. It gives significant growth along with thermal stability of TL peak followed by elevated temperature OSL under implemented protocol.

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References:

1. A. G. Wintle, Radiation Measurements. 27 (1997) 769.
2. S. W. S. Mckeever et al., Radiation Measurements. 27 (1997) 161.
3. Y. D. Kale and Y. H. Gandhi, Indian Journal of Pure and Applied Physics 47 (2009) 413.
4. P. Saha et al., Trans. Indian Ceram. Soc. 50(5) (1991) 129.
5. A. G. Wintle et al., Radiation Measurements. 27 (1997) 611.
6. P. G. Benny et al., Radiation Measurements. 32 (2000) 247.
7. R. M. Bailey, Radiation Measurements. 32 (2000) 233.