Characterization of TL-D200 and TL-D100 for Thermoluminescent Radiation Dosimetry

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***Abstract*— The thermoluminescence (TL) properties of TLD-100 and TLD-200 have been studied and their reproducibility, Lower detection limits, Calibration curve and fading are discussed. It is found TLD-200 samples presented the highest TL sensitive from TLD100 and that all the batches have high uniformity which makes them capable for environmental use .it has been shown that two is good reproducibility in the measurement as the results have indicated it is found that the coefficient of variation for TLD-100 and TLD-200 are 3.15, 2.25 respectively. The rate of thermal fading of both Lithium fluoride and calcium fluoride dosimeters equals (11%,13%) respectively for three months.**

***Index Terms*—TL, TLD 100, TLD-200., Lithium fluoride, calcium fluoride**

I. INTRODUCTION

A thermoluminescent dosimeter, or TLD, is a type of radiation dosimeter. A TLD measures ionizing- radiation exposure by measuring the intensity of visible light emitted from a crystal in the detector when the crystal is heated. The intensity of light emitted is dependent upon the radiation exposure.Materials exhibiting thermoluminescence in response to ionizing radiation include but are not limited to calcium fluoride, lithium fluoride, calcium sulfate, lithiumborate, calciumbo rate , potassium bromide e and feldspar. It was invented in 1954 by Professor Farrington Daniels of the University of Wisconsin-Madison [1]. The two most common types of TLDs are calciumfluoride and lithium fluoride, with one or more impurities to produce trap states for energetic electrons. The former is used to record gamma exposure, the latter for gamma and neutron exposure (indirectly, using the Li-6 (n, alpha) nuclearreaction; for this reason, LiF dosimeters may be enriched in lithium-6 to enhance this effect or enriched in lithium-7 to reduce it). Other types include berylliumoxide [2] calciumsulfate doped with Tm [3.]As the radiation interacts with the crystal it causes electrons in the crystal's atoms to jump to higher energy states, where they stay trapped due to intentionally introduced impurities (usually manganese or magnesium) in the crystal,[4] until heated. Heating the crystal causes the electrons to drop back to their ground state, releasing a photon of energy equal to the energy difference between the trap state and the ground state. The use of thermoluminescence in dosimetry date from 1940,

when the number of people working on places with radiation sources such as hospitals, nuclear reactors etc. exposed to ionizing radiations (γ-rays, X rays, α and β-particles, UVA and UVB) increased and efforts to develop new types of dosimeters began [5].In this paper we present sensitivity, calibration curve and thermal fading for the dosimeters of TLD-100 and TLD-200.

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II. MATERIAL AND METHODS

A series of experiments are conducted by using two groups of thermoluminscence dosimeters one of which include lithium fluoride dosimeters and the other calcium fluoride dosimeters and each group contain 20 dosimeters.

1-Pre-irradiation annealing

To drain the electrons traps that they contain because of their exposure to background radiations in the laboratory or to get rid of the remaining electrons trapped in the deep traps because of previous irradiation processes [6] which the measuring instruments fail to drain during thermoluminescence, we use the method recommended by the researchers in this field and which includes putting the dosimeters in an Oven at 400 ^oC for one hour then moving them directly to another Oven at 100 ^oC for two hours, then leave it to cool down at the room temperature every time before the use of dosimeters for irradiation [7,8]. Also this treatment increases the sensitivity of a dosimeter [9].

2-Post-Irradiation Annealing.

This process is used so as to get rid of the glow peaks that fade at room temperature, i.e. the low temperature peaks [10]. The dosimeters are put in an oven at 100 ^oC for 20 minutes directly after irradiation, and they are left to cool at room temperature, then they are ready to be read in the thermoluminescence reader**.**

3-Condition of Measuring.

The dosimeter reading is registered by the thermoluminescence reader at a heating rate of 5 ^oC/sec and to a temperature 300 ^oC for the dosimeters of lithium fluoride TL-D100 and to a temperature 320 ^oC for the dosimeters of Calcium fluoride TL-D200. Furthermore, the red light is used in the laboratory when the dosimeters are placed in the thermoluminescence reader in order to avoid the effect of ordinary light on them.

III. RESULTS AND CONCLUSION

1-Reproducibility.

The reproducibility of the TL response of the two materials was obtained by their TL evaluation for each dosimeter type after successive procedures of standard thermal treatments and irradiation with the Cs-137 source. The individual reproducibility (coefficient of variation) obtained for the TL detectors irradiated with 9.5 mrad Cs-137 are presented in Table 1. Also, it is found that the zero dose reading for lithium