



SNS COLLEGE OF ALLIED HEALTH SCIENCES- COIMBATORE 35



DEPARTMENT : RADIOGRAPHY AND IMAGNG TECHNOLOGY

**SUBJECT : GENERAL PHYSICS, RADIATION PHYSICS AND PHYSICS OF
DIAGNOSTIC RADIOLOGY**

PAPER : PAPER II (UNIT 5 – PHYSICS OF DIAGNOSTIC RADIOLOGY : X-ray TUBE)

TOPIC : 12. THERMO LUMINESCENCE DOSIMETER (TLD)

THERMO LUMINESCENCE DOSIMETER

- Thermo luminescence dosimeters are used to measure individual external doses from X-rays, beta and gamma radiations.
- These dosimeters are based on the thermo luminescence principle. Certain materials can absorb energy after radiation exposure.
- When these materials are heated, the energy is released in the form of visible light.
- The quantity of the visible light emitted is found to be proportional to the energy absorbed by the TL-material.
- TLD can be used to measure radiation from 10 mR to 10,000 R with an accuracy of +/- 10%, and it can detect a minimum dose of 0.2mSv to 10 Sv

CONSTRUCTION

- TLD badge consists of- TLD card and TLD cassette





THERMO LUMINESCENCE DOSIMETER



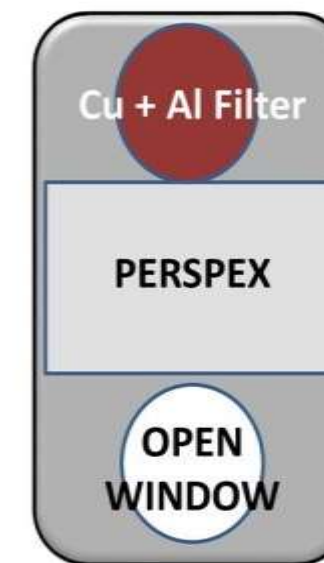
TLD CARD

- Dy - Dysprosium Tm - Thulium. CaSO_4 is commonly used as TLD because it has a high sensitivity toward radiation.
- The thermo luminescence characteristic can be improved by adding a dopant (impurity). Dy and Tm are the types of rare-earth metals which are added with CaSO_4 to improve the thermo luminescence characteristic of CaSO_4 .
- ATLD card consists of nickel-plated aluminum. It contains three circular holes. Each hole contains TL Disc.
- The TL discs are made from a homogeneous mixture of CaSO_4 : Dy phosphor (calcium sulfate doped with dysprosium) in a weight ratio of 1:3.
- Each disc is having a diameter of 13.3mm, a thickness of 0.8mm, and weights 280 mg.
- An asymmetric V cut is provided at one end of the card to ensure a fixed orientation of the card in the TLD cassette.
- To protect the TLD discs from dust and mishandling, the card is wrapped and sealed in a thin plastic pouch. Pouch also protects the card from radioactive and chemical contamination while the user is working with open sources or chemicals.

THERMO LUMINESCENCE DOSIMETER

TLD CASSETTE

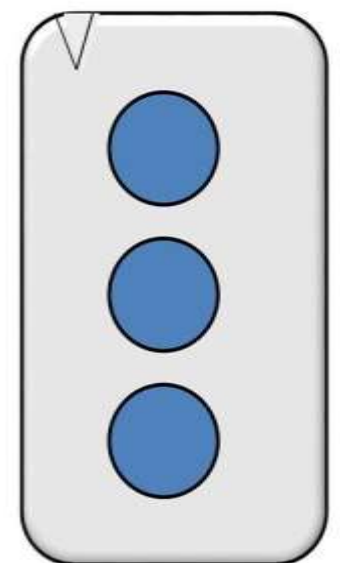
- It is made up of plastic.
- There are three windows in the cassette - Cu+Al filter, plastic (PERSPEX), and the open window.
- A metal clip attachment attaches the badge to the user's clothing.
- **Copper + Aluminum Filter** : It is made up of 1mm Al and 0.9 mm Cu. It detects X-ray and gamma radiation. The Aluminum Filter should face the radiation, and copper should face the TLD disc.
- **Plastic (PERSPEX)** : It is made up of 1.5 mm plastic. It detects beta rays.
- **Open window** : It detects alpha rays.



TLD CASSETTE



TLD BATCH

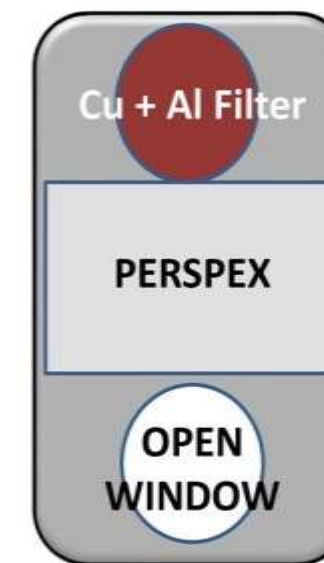


TLD CARD

THERMO LUMINESCENCE DOSIMETER

Position of TL Disc

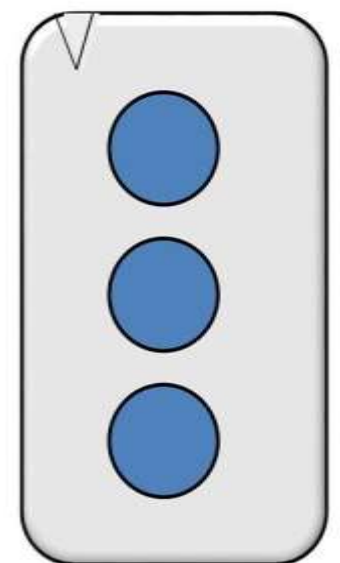
- 1st disc is sandwiched between pair of the filter of 1mm Al and 0.9mm Cu.
- 2nd disc is sandwiched between pair of 1.5mm thick Plastic filters.
- 3rd disc is positioned under a circular open window.



TLD CASSETTE



TLD BATCH

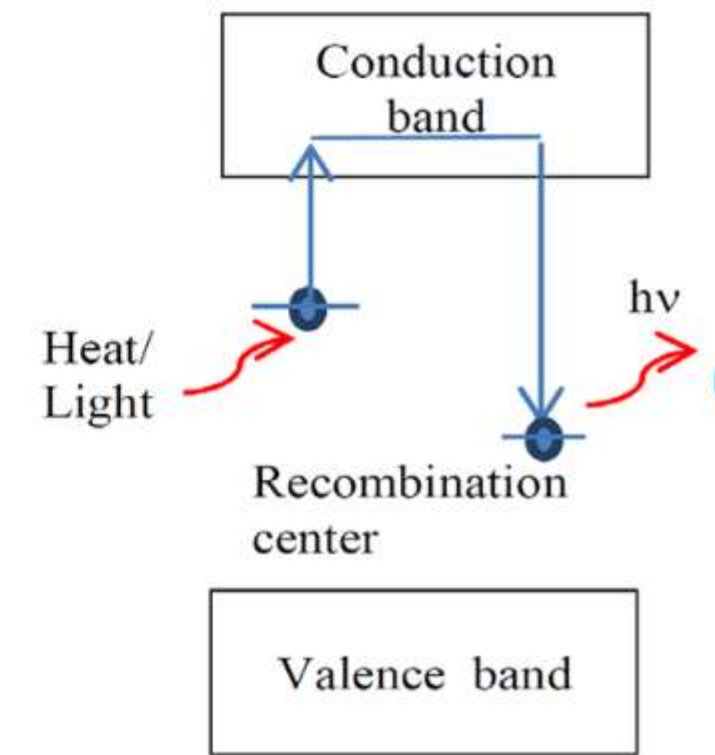
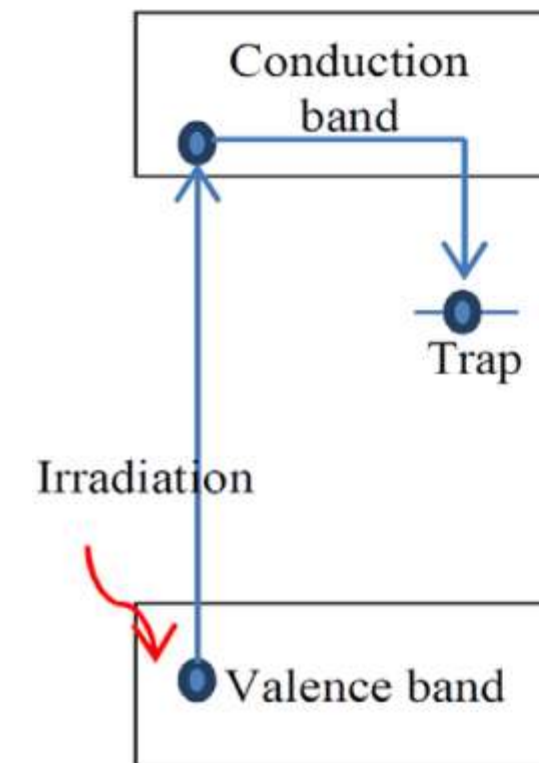


TLD CARD

THERMO LUMINESCENCE DOSIMETER

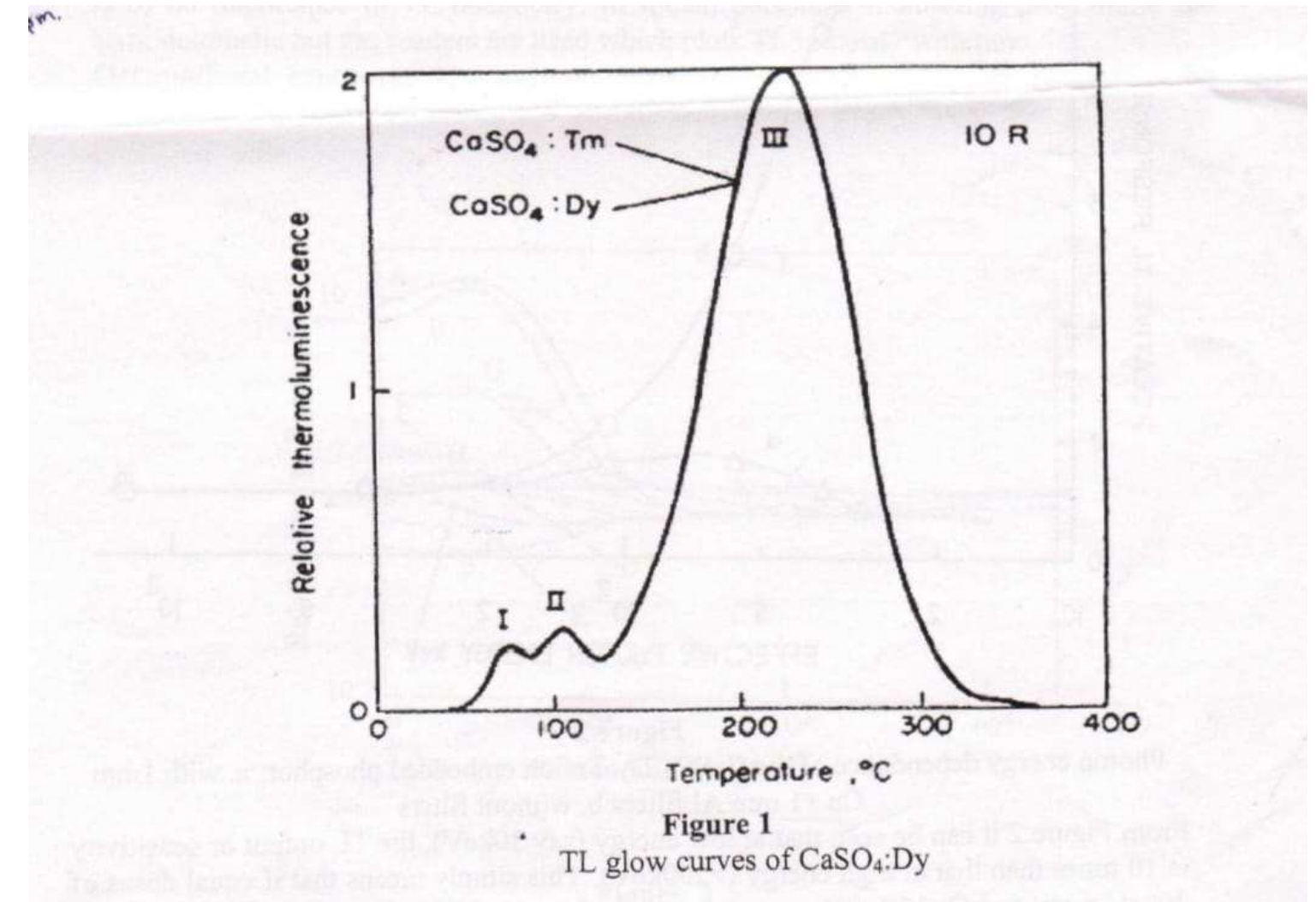
PRINCIPLE

- When the TLD is irradiated to the radiation, electrons in the valance band absorb the energy and jump to the conduction band.
- These excited electrons are trapped in the forbidden energy gap.
- When this TLD card is heated in the TLD reader, the trapped electrons absorb energy and return to their ground state and emit light.
- The emitted light is captured by a PMT tube (photomultiplier tube).
- The PMT amplifies and converts the light into an electric signal, which is measured in mR or mSv.



TLD GLOW CURVE

- For fast neutron monitoring. CR-39 Solid State Track Nuclear Detectors (SSTND) are used.
- The $\text{CaSO}_4 : \text{Dy}$ TLD badge is intended to measure only x. B and y and has negligible thermal neutron response.





THERMO LUMINESCENCE DOSIMETER



ADVANTAGE OF TLD BADGE

- Higher Sensitivity.
- Wide range of dose (0.1mSv-5Sv).
- Direct reading of personal dose.
- Tissue equivalent.
- Small in size.
- A small change in sensitivity with the change in radiation quality.
- Chips can be reused.
- It can be store doses for long periods.
- Automated readouts. It is quick.

DISADVANTAGES

1. It doesn't provide a permanent record.
2. Cannot distinguish radioactive contamination.



THERMO LUMINESCENCE DOSIMETER



GUIDELINES FOR USING TLD BADGE

- TLD badges are to be used only by persons directly working in radiation. Administrators, darkroom assistant, sweepers, etc. need not be provided with TLD badges.
- TLD badge is used to measure the radiation dose. It does not protect the user from the radiation.
- The name, personnel number, type of radiation (X or gamma), period of use, location on the body (chest or wrist), etc., should be written legibly in block letters on the front side of the badge.
- A TLD badge once issued to a person should not be used by any other person.
- Each institution must keep one TLD card loaded in a chest TLD holder as control, which is required for correct dose evaluation. It should be stored in a radiation free area, where there is no likelihood of any radiation exposure. TLD badge should be worn compulsorily at the chest level.





THERMO LUMINESCENCE DOSIMETER



GUIDELINES FOR USING TLD BADGE

- TLD badge should be worn compulsorily at the chest level. It represents the whole body dose equivalent. If lead apron is used, TLD badge should be worn under the lead apron.
- While leaving the premises of the institute, workers should deposit their badges in the place where control TLD is kept.
- A badge without filter or damaged filter should not be used. It is replaced by a new holder.
- Every radiation worker must ensure that the badge is not left in the radiation field or near hot plates, ovens, furnaces, burners, etc.
- Every new radiation worker has to fill up the personnel data form, and should be to the BARC accredited agency.
- All the used or unused TLD badges should be return, after every service period (quarterly) in one lot so as to reach 10th of next month.
- Contact for all correspondence regarding TLD badge service, to the Officer-in-charge, Personnel Dosimetry and Dose record section, Radiological physics and Advisory division, Bhabha Atomic Research Centre, CT and CRS Building, Anusakti Nagar, Mumbai 400094.



INTERROGATIONS



1. What is TLD ?
2. What kind of Material is used in TLD ?
3. Working principle of TLD.



REFERENCES

1. Physics for Radiography - Hay and Hughs
2. Ball and mores essential physics radiographers, IV edition, Blackwell publishing.
3. Basic Medical Radiation physics – Stanton.
4. Christensen's Physics of Diagnostic Radiology – Christensen.
5. The physics of Radiology and Imaging – K Thayalan.



THANK YOU