RADIATION DOSIMETRY AT IPEN

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Many dosimetric systems have been suggested to radiation dosimetry. Some of the criteria which govern the choice of a dosimetric system are[1]:

Whether an absolute method is required;

Accuracy and precision required;

Whether total absorbed dose or absorbed dose rate is required;

Whether an immediate read-out is required;

Range of absorbed dose to be measured;

Range of absorbed dose rate to be measured;

Type and energy of radiation to be measured;

Need to match dosimeter to medium;

Size of detector required;

Spatial resolution required;

Convenience;

Cost;

Ruggedness.

The most widely used dosimetric systems are Calorimetry, Ionization, Chermical, Thermoluminescence, Photographic, Scintillation, Silicon, Plastics and Vacuum Chamber.

With the development of the nuclear programme in Brazil, the need of environmental and personnel monitoring becomes imperative. In vien of saving foreign currency and becoming self sufficient in this field and considering the criteria of choice

of a dosimetric system the Radiological Protection Department of IPEN primary decided to develop thermoluminescent (TL) materials. The $CaSO_4$:Dy thermoluminescent phosphor was chosen due to its high sensitivity, wide range of utilization, ease of preparation and comparatively low cost.

A new preparation method for the obtention of TL dosimetric single crystals of $CaSO_4$:Dy of optical quality for dosimetric and physical studies was developed[2]. Presently single crystals are grown using the method of slow evaporation in a sealed system and the crystallization can be controlled varying the temperature and gas flow rate.

Extensive work was done during many years in order to study in detail all $CaSO_4$:Dy characteristics from the point of view of dosimetry, with the purpose of introducing it in the routine use. A preparation method of solid dosimeters was also developed so that $CaSO_4$:Dy + Teflon pellets of different thickness are presently being produced. Normally 0.80 mm thick pellets have been used for X and gamma radiation detection[3] and 0.20 mm thick pellets for beta radiation absorbed dose assessment[4,5].

In environmental and personnel monitoring a wide range of unknown radiation energies is present; therefore radiation dosemeters with low energy dependent response relative to air are prefered. In the case of $CaSO_4$:Dy Teflon pellets the method of partial surface shielding[6] filters was applied to reduce the energy dependence of its TL response. Detailed work showed that the use of 1.0 mm thick lead filter in combination with a 3 mm thick plastic filter provides a cutoff in the 100 keV region and a uniforme response above this energy. On the other hand, a 0.8 mm thick lead filter with a 2 mm diameter central hole together with a 3 mm thick plastic filter provides a nearly independent TL response from 20 keV to 1.25 MeV. A third filter of plastic 3 mm thick provides electronic equilibrium

for the ^{60}Co gamma ray energy.

Thus the final dosimeter badge proposed for radiation monitoring should contain three dosimetric pellets placed between the pairs of described filters. This filter combination permits a good radiation quality estimation.

A beta/gamma discriminating dosimeter was developed and used in order to evaluate the external and internal contamination in some victims of the Goiânia ^{137}Cs radiological accident[5]. This dosimeter consists of four 0.20 mm thick pellets sealed in a black plastic film. Two pellets are shielded with PTFE filters 315 $mg.cm^2$ thick. This filter guaranties electronic equilibrium for ^{60}Co gamma rays. The other two remaining pellets are unshielded. The shielded pellets are used for gamma-dose assessment, while the other two pellets for beta-dose assessment.

Good results were also obtained using 0.80 mm thick $CaSO_4$:Dy pellets, for low energy X rays emitted from video display terminals measurements[7].

Presently 30,000 pellets are produced and sold to individual monitoring, services universities and researcher centers. They have been also used by the department to routine works in dosimetry.

Other thermoluminescent materials have been developed and produced by the Dosimetric Material Production Laboratory. A simple method of growing LiF (Mg,Ti)[8] crystals was developed, and LiF crystals with the same TL properties of commercially available imported Harshaw TLD-100 material were obtained. Pellets were produced from them by cold pressing and sentering. At present, they are available for sale in powder and pellet form.

Two years ago the Laboratory started to investigate the synthesis and dosimetric properties of MgB_4O_7:Dy and

$CaB_4O_7:Dy$[9]. The optimum Dy concentration was determined, a synthesis method was developed and their dosimetric properties are presently being investigated.

In synthesis, the main objective of the Material Production Laboratory is the research, development and production of preferably totally national TL materials, presenting good dosimetric properties and low cost, what of bigh interest for our country.

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