ELECTRETS FOR BETA RADIATION DETECTION *

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Electret dosimetry has been reviewed by Gross . A cylindrical electret ionization-chamber type dosimeter has been studied for X and gamma rays and neutrons . The principle of the dosimeter is electret charge compensation due to ionization in the chamber volume.

Electret ionization chambers can be designed with one or more electrets, in various shapes. This study is concerned with a simple system, similar to a cylindrical ionization chamber (sensitive volume: 3.5cm^3) using teflon electrets. Aluminum and lucite were used as wall-materials. Other experiences were performed using chambers without wall, i. e, without defined sensitive volume.

The teflon electrets were obtained by Corona discharge in the gas surrounding them. The measurement of the electret charge was made by induction using a co-axial insulated metal chamber connected to a Keithley 610ºC electrometer. By measuring the charge before and after irradiation it is possible to obtain a calibration curve: charge (Q) versus absorbed dose (D) for the dosimeter. The irradiation setup used was the Beta Secondary Standard System of IPEN calibration laboratory with four beta

sources: ^{90}Sr - ^{90}Y (74 and 1850 MBq), ^{204}Tl (18,5 MBq) and ^{147}Pm (518 MBq). In some cases a ^{85}Kr source was also used.

The electrets were tested in different radiation field geometries: electret axis parallel and perpendicular to the field.

1) Parallel geometry, lucite walled detector. The absorbed dose response to ^{90}Sr - ^{90}Y, ^{204}Tl and ^{85}Kr sources presented linear behaviour between 2.5 and 40 mGy. The inverse square law relationship was observed for the electret response, varying the source-detector distance, using ^{90}Sr-^{90}Y (11 to 50cm), ^{204}Tl (15 to 40cm) and ^{85}Kr (15 to 50cm) sources. These results agree with those of reference 5. The energy dependence for ^{204}Tl radiation of the electret response in this case was 23% normalized to ^{90}Sr - ^{90}Y radiation.

2) Parallel geometry, aluminum walled detector

The results were similar to those of case 1.

3) Perpendicular geometry, aluminum walled detector.

In these conditions, the electret detector sensitivity was strongly higher: the linearity was observed between 40 and 600 μGy. The response with distance showed the same behaviour as in case 1. The energy dependence of the electret response was only 7% in this case. Varying the aluminum absorbing thickness between 0.04 and 0.24cm, the electret response to ^{85}Kr radiation was measured: the observed decay was about 157%.

4) Perpendicular geometry, lucite walled detector

In this case the sensitivity was not high enough for beta radiation detection.

5) Perpendicular geometry, open detector (without wall)

This special geometry permits maximum charge collection volume, making possible very low dose determinations: 2.5 μGy, using ^{90}Sr - ^{90}Y and ^{204}Tl radiation fields. The dose response linearity was observed from 2.5 to 40 μGy. The electret response is energy independent under these conditions.

In conclusion, depending on the wall material and radiation field geometry, the teflon electret detector can be used for different dose interval determinations, using beta radiation.

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