

CHARACTERISTICS OF A GAS-FLOW PROPORTIONAL COUNTER FOR EXOELECTRON EMISSION STUDIES

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ABSTRACT

The main characteristics of a gas-flow proportional counter for exoelectron studies are presented. Results on its design features, counting curves and tests with BeO thin films dosimeters are presented.

INTRODUCTION

The increasing use of radioactive sources in medicine, industry and research has led to a growth in the number of persons exposed to some kind of ionizing radiation, therefore the importance of an accurate dosimetry.

Thermally Stimulated Exoelectron Emission (TSEE), consisting of low energy electrons that are emitted from surfaces of many insulating solids at temperatures below those at which thermionic emission occurs [1], is a technique that can be used to measure weakly penetrating radiations, such as alpha and beta particles and low energy X-rays [2,3].

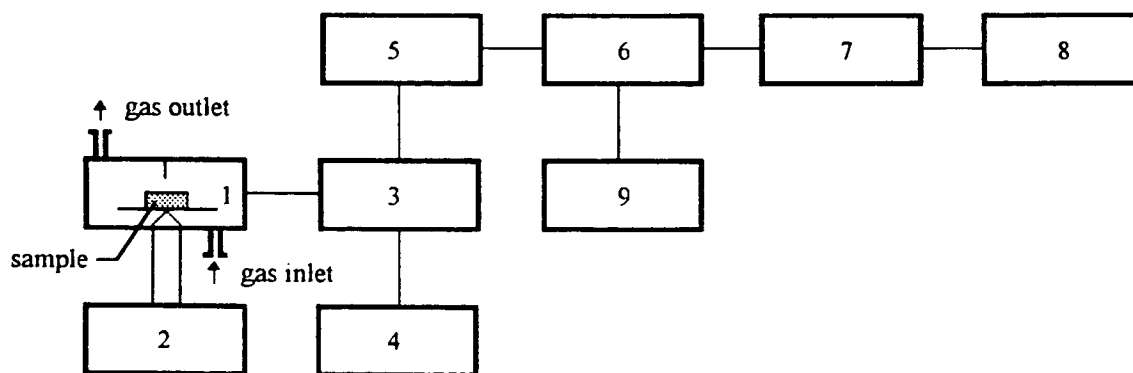
The principles of exoelectron emission are very similar to those of thermoluminescence. Due to an exposure to ionizing radiation, electron traps in the energy band gap of an insulator are occupied. During the heating, the trapped electrons are released and are emitted from the surface of the crystal, if their energy exceeds the electron affinity. The emitted electrons are called exoelectrons and the curve of this emission as a function of temperature is called TSEE glow curve [2,4].

Usually exoelectrons are measured with particle counters, such as windowless Geiger-Müller detectors, ionization chambers or proportional counters [1,5,6]. Sometimes, exoelectrons emission studies have to be performed in high vacuum conditions; in this case an electron multiplier is employed. Normally, this equipment is used preferentially for experimental research than for practical dosimetric purposes. In all devices, the samples are linearly heated up to a certain temperature.

In this work the characteristics of a windowless gas-flow proportional counter and the TSEE glow curves of BeO thin films, submitted previously to gamma radiation of ^{60}Co are presented, in order to verify their usefulness for dosimetric purposes.

MATERIALS AND METHODS

The experiments were carried out with a 2π windowless proportional counter with hemispherical volume and with P-10 gas flow (10% Methane + 90% Argon). The diameter of the gold wire is 50 μm and the operating high voltage is 2,0 kV. The samples are inserted into the counter and are fixed on a heater plate (Monel) ; they are linearly heated at a rate of 16 $^{\circ}\text{C}/\text{s}$. The temperature control for linear heating is carried out by a temperature programmer (TP-2000, Theall Engineering Company), that provides rates between 0,1 and 16 $^{\circ}\text{C}/\text{s}$, from room temperature up to about 400 $^{\circ}\text{C}$. The glow curves were recorded in a multichannel analyser 7450 EG&G - Ortec. The block diagram of the TSEE counting system is shown in Figure 1.



- 1 - Proportional Detector
- 2 - Temperature Programmer TP-2000
- 3 - Preamplifier - 109 PC, Ortec
- 4 - High Voltage Power Supply, Micronal, Model 1023
- 5 - Amplifier, Micronal, Model 4012
- 6 - Discriminator, Micronal, Model 4010
- 7 - Scaler, Micronal, Model 10024
- 8 - Ratemeter, Ortec, Model 441
- 9 - Multichannel Analyser, 7450 EG&G, Ortec

Figure 1. Block Diagram of the TSEE Counting System

The counting curves of this detector were obtained using calibrated sources of ^{241}Am (α) and ^{14}C (β) from the Nuclear Metrology Laboratory of IPEN.

RESULTS

In order to define the proportional region of this detector, the amplitude of the observed pulses versus the applied voltage was obtained using calibrated sources of ^{241}Am and ^{14}C . These results are shown in Figure 2.

In the case of beta radiation, the particle range exceeds the detector dimensions, thus the number of ion pairs produced in the gas is proportional to only that small fraction of the particle

energy lost in the gas.

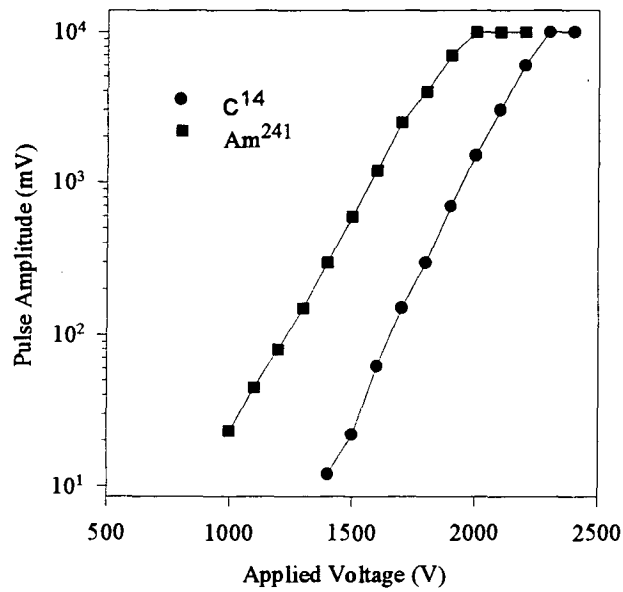


Figure 2. Pulse Amplitude versus the Applied Voltage for ^{241}Am and ^{14}C Sources.

The selection of the detector operating voltage was made using the counting rate versus the applied voltage curve obtained using the ^{14}C source. The operating voltage possibilities correspond to a flat region or a "plateau" on the resulting curve; in this case 2,0 kV was chosen and the curve is presented in Figure 3.

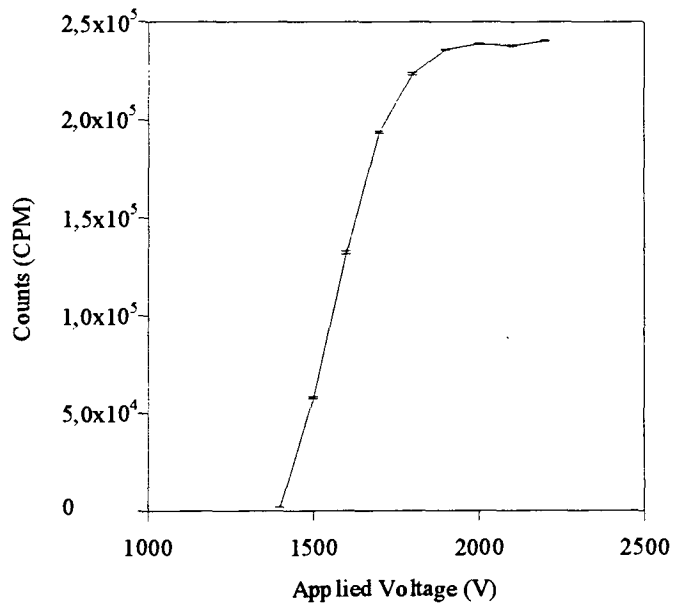


Figure 3. Counting Rate versus Applied Voltage for the Proportional Counter.

As an example for TSEE application, glow curves were obtained using samples of BeO thin films on quartz substrates. In Figure 4 a typical TSEE glow curve can be observed. The peak temperature (305 °C) and curve shape are similar to those presented by others authors [1,7,8].

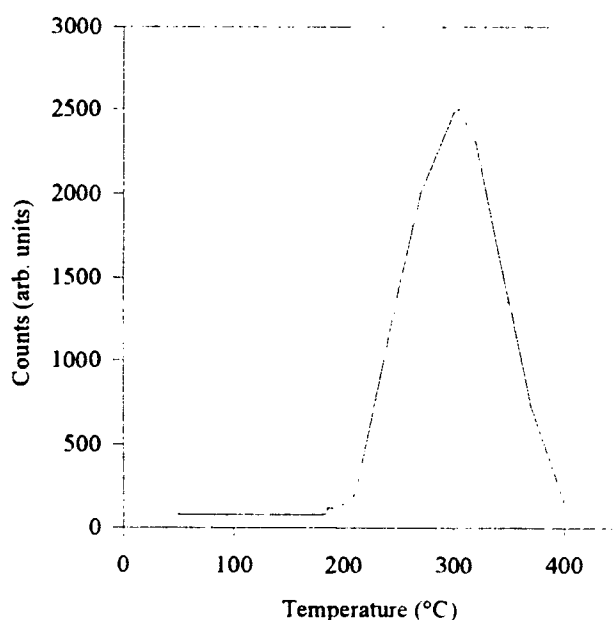


Figure 4. Glow Curve of BeO Thin Film Dosimeter Irradiated with 1 Gy of ^{60}Co .

CONCLUSION

A gas flow proportional counter was built at IPEN to detect exoelectrons of dosimetric samples. The main characteristics of the flow counter presented in this work show its usefulness for exoelectron studies.

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CONTAMINAÇÃO INTERNA POR I-131 INCORPORADO ACIDENTALMENTE EM UM LABORATÓRIO DE ANÁLISES CLÍNICAS

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ABSTRACT

This paper presents the evolution of the internal contamination, by I-131, of a woman who worked cleaning glassware in a clinical analysis laboratory. The contamination was detected through an examination in the whole-body-counter of Nuclear Technology Development Center - CDTN - in Belo Horizonte.

In the following days, urine samples of the patient were collected and analyzed, confirming internal contamination.

CDTN's Radiological Protection Service staff adapted equipment for detection of hands and thyroid contamination, and used a well-type detector for urine analysis, to obtain more detailed information about the case.

All other employees of the laboratory were also monitored, being detected small contamination on the hands of three of them. However, no evidence of internal contamination was found.

The monitoring of the internally contaminated patient was carried on for three months, and the results showed that an incorporation in the thyroid gland in the order of 10^7 Bq occurred, which has decayed with an effective half-life of 7.1 days. The corresponding estimated dose equivalent in the thyroid was 22 Sv.

INTRODUÇÃO

O objetivo deste trabalho é descrever o acompanhamento da evolução da contaminação, por I-131, de uma funcionária de um laboratório de análises clínicas.

Nas seções subseqüentes, são abordados o atendimento e as primeiras medidas de contaminação realizadas no contador de corpo inteiro do CDTN, as contagens de urina da paciente, a instalação e utilização de outros equipamentos de medida, os exames dos outros funcionários do laboratório e as estimativas da dose devida à incorporação. O APÊNDICE A contém os resultados das medidas e