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Manufactured Silicon Diode used as an Internal Conversion Electrons Detector

Alan Anatoly S. Corrêa, Carmen C. B. Tobias, Josemary A. C. Gonçalves, Pedro F. P. Rato Mendes, José Kleber da Cunha Pinto, Jair P. de Souza, Marcello Damy de S. Santos

The direct detection capabilities of one silicon diode manufactured at CERN (RD-15 collaboration)for both beta particles and internal conversion electrons have been studied . This ion-implanted diode (type Al/n^+/p/n/Al), developed in the framework of R&D programs for the future CMS experiment at Large Hadron Collider (LHC), bears excellent timing properties and high radiation hardness that fulfill the requirements from this accelerator environment. Apart from this diode application, we were encouraged to study its performance for low energy electron and beta particles detection and spectrometry envisaging its use in an electron or beta-gamma coincidence system for nuclear parameters measurements.

The electric contacts of the diode were made at LME/USP, as well as the measurements of its capacity and leakage current as a function of the bias voltage. In order to use this diode as a detector, it was placed inside a stainless steel vacuum chamber and directly connected to a charge sensitive amplifier based on an integrated circuit A250 from *Amptek*. This circuit, originally projected for electromagnetic radiation detection, was slightly modified to match the characteristic of higher charge per pulse associated with charged particles. The pulses from the A250 were shaped and amplified by a linear amplifier and fed to a multichannel analyzer.

The response of the diode for beta particles and internal conversion electrons was studied by using ^{32}P and ^{133}Ba radioactive sources, respectively. The behavior of the diode relative efficiency as a function of the voltage for both radiations showed that the counting rate increases with the applied voltage as a consequence of the depletion layer enlargement (maximum 200μm at full depletion, estimated from the diode capacitance measurements).

The spectrometric performance of the diode for internal conversion electrons from the ^{133}Ba source was studied recording several energy spectra under different experimental conditions at room temperature. Until now, the best result obtained clearly shows the lines corresponding to the electrons of 45.01keV up to 347.87keV (FWHM = 6.2keV). It should be pointed out, however, that besides the contribution of the preamplifier electronic noise to the broadening of the electron lines, the deterioration of the obtained energy resolution can be attributed to both the energy loss in the diode dead layer and in the *makrofol* covering of the ^{133}Ba source. Nevertheless, the energy resolutions measured are sufficiently good to justify the use of this diode for spectrometry of internal conversion electrons.

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The Transition from Proportional to Streamer Mode in Resistive Detectors

Carmen C. B. Tobias, Josemary A. C. Gonçalves, M. Margarida R. F. Fraga, Paula R. C. Lopes, Marcello Damy de S. Santos

Detectors with highly resistive electrodes, particularly resistive plate chambers (RPC's), have been studied extensively in recent years. Due to its ease of construction and operation, the low cost and the good time resolution, it has been proposed as a suitable detector for the muon trigger for the Large Hadron Collider experiments. However, when RPC's are operated in spark mode, it was found that these devices were only able to operate efficiently at low rates (100Hz/cm^2). This behavior was attributed to the mechanism whereby following each spark the charge was deposited on the resistive electrodes, causing the reduction of the electric field across the gas gap. Therefore, there is interest in operating these detectors in regimes where the charge per pulse is much smaller than those associated with spark signals such as proportional or self quenching streamer (SQS) modes.

In this work we decided to use the classical proportional counter geometry, with a resistive cylindrical tube as the cathode, rather then parallel geometry. Indeed, the large amount of information available from SQS using all metal cylindrical counters can be applied, within certain limits, to explain the behavior of the possible streamer data from the resistive detector.

The experimental results were obtained with a long cylindrical counter made of glass (resistivity about 7x10$^{12}\Omega.cm$) fitted with a stainless steel anode wire (50μm of diameter). The tube was divided into two sections: one of them was covered externally with a thin grounded layer of *Eletrodag*, forming a simple resistive detector (RD), while the other was covered internally by the same layer as a conventional metallic counter (MD).

The Ar/Isobutane and Ar/Etane gas mixtures were used for the measurements related to the transition from the proportional to the self quenching streamer mode under X-rays irradiation from a ^{109}Cd source. The charge spectra were measured using a conventional charge amplifier electronic system and a multichannel analyzer, calibrated using a standard pulse generator. The results obtained with the RD detector showed for both gas mixtures the characteristic discontinuous transition (with efficiency about 50%) from proportional to SQS avalanches. It is important to stress that, although the charge per pulse was increased with the applied voltage, it was clearly visible the loss of pulse height along proportional and the streamer regions, being more pronounced for the higher rate.