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Cadmium Telluride Nuclear Radiation Detectors *

P. Höschl, P. Polívka, V. Prosser, M. Skřivánková, M. Vidra

Institute of Physics of the Charles University

121 16 Prague 2, Ke Karlovu 5, Czechoslovakia

Cadmium telluride has a high average atomic number of 50 (Z_{Cd} = 48, Z_{Te} = 52) large band gap of 1.45 eV, relatively high electron and hole mobilities of 10^3 and $10^2 cm^2/V.sec$ respectively and intrinsic carrier concentration at the room temperature about $10^7 cm^{-3}$. For these reasons, CdTe was selected as the most likely material capable of operating as a gamma-ray spectrometer at room temperature. CdTe has excellent gamma-ray stopping power comparison with traditional semiconductor detector materials Ge and Si. For photon energy of 100 keV the total absorption coefficient of CdTe is 20 times higher than that of Si (commonly used for room temperature operations) and the photoelectric absorption coefficient is 100 times higher than that of Si.

The growth of CdTe from a Te solvent has been used to obtain material for use as nuclear radiation detectors. The relatively low temperature (700-450°C) used in a modified traveling heater method is appropriate for eliminating of impurities from the crucible and reducing the equilibrium defect concentration. Ingots have been doped with chlorine in the form of anhydrous cadmium salt, $CdCl_2$.

The material is p-type with resistivity $\rho \approx 10^9 \Omega$ - cm, hole concentration $10^8 cm^{-3}$, electron and hole mobility $\mu_e \approx 1050$ and $\mu_h \approx 80\ cm^2/V.sec$ respectively, electron and hole mobility - trapping time (τ^+) products $\mu_e \tau^+_e \approx 5.10^{-4}$ and $\mu_h \tau^+_h \approx 5.10^{-3} cm^2/V$ respectively and trapping levels: E_c - 0.02 eV, E_v + 0.15eV E_v + 0.3 eV, E_v + 0.4 eV, E_v + 0.6 eV.

The detectors were fabricated by chemical deposition of thin Au or Pt layer (non injecting contacts) on the two opposite parallel mechanically polished surfaces of CdTe wafer (5x5x1 mm^3). The quality of detectors was tested by ^{57}Co and ^{241}Am. In ^{57}Co spectrum, low noise is demonstrated by the presence of 14 - keV peak and very well resolution ($\approx$ 6% FWHM) is evident from the separation of the 122 - and 136 - keV peaks. In ^{241}Am spectrum both peaks $L\alpha_{1,2}$ 14 - keV and $L\beta_{1(2)}$ 18 - keV are well resolved. The CdTe detectors are stable with time; they exhibit no polarization.

Even if CdTe detectors do not reach the resolution of Ge or Si detectors, there are other applications, where the small size, portability and operating

temperature around 30°C is required. CdTe detectors are expected to be used as perspective medical detectors, in non destructive analysis of nuclear fuels as thickness monitors etc.

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