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COMMUNICATIONS

PHONON DRAG EFFECT AND DETECTION PERFORMANCE OF GAMMA RAYS IN P–CdTe

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Cadmium telluride (CdTe) and cadmium zinc telluride (CdZnTe) are regarded as promising materials for the exploitation in imaging detectors for X-ray and gamma ray spectroscopy, not only in high- energy physics but also in astrophysics, medicine and ecology. There are at least two good reasons for such expectations, namely the high atomic numbers in comparison with for instance Si (ZCd = 48, ZTe = 52) and the large band gap (Eg = 1,5 eV), which allows to operate the detector at room temperature.

K e y w o r d s: X-ray, gamma ray spectroscopy, Cadmium telluride, radiation detectors

1 INTRODUCTION

Cadmium telluride (CdTe) and cadmium zinc telluride (CdZnTe) are regarded as promising materials for the exploitation in imaging detectors for X-ray and gamma ray spectroscopy, not only in high- energy physics but also in astrophysics, medicine and ecology. There are at least two good reasons for such expectations, namely the high atomic numbers in comparison with for instance Si (ZCd = 48, ZTe = 52) and the large band gap (Eg = 1,5 eV), which allows to operate the detector at room temperature. Due to recent [1] improvements in the technology of crystal production and in the design of electrodes as well, the above mentioned application is becoming very promising. As it is well known, the problem of inefficient charge collection in these materials reducing the energy resolution is connected with the low mobility and the short lifetime of holes. For this reason we focused our attention not only on characterization of new CdTe materials but also on preparation of radiation detectors and their spectral analysis. For our investigation we have used as a bulk material single crystals of p-type CdTe (produced by Chernivtsy National University, Ukraine).

2 EXPERIMENTAL

There are some technical problems, which are known, but not often mentioned in published articles. One of the very important factors in the selection of the suitable semiconductor is the quality of the crystal lattice. Our many years experience and experiments [2 - 7] performed have shown that very significant information on it can be obtained from investigations of the phonon drag effect (*eg* by means of Seebeck and Hall effect measurements) [2]. The procedure is very simple. It is based on the calculation of the Fermi level from Hall effect measurements and through it of the theoretical value of the Seebeck coefficient. Great difference between the experimental and calculated values indicates [2, 7] the presence of a strong phonon drag effect in which the dominant role belongs to optical phonons. If we correlate as known the detection performance for gamma rays and the mentioned phonon

Table 1. Room temperature values of same measured samples CdTe (* see Fig. 1)

Type	Sample	Concentration (cm^{-3})	Mobility (cm^2/Vs)	Seebeck coefficient (mV/K)		Phonon drag effect	Detection
				measured	calculated		
p	C40a	8.5×10^8	42	2.03	2.45	0.42	yes*
p	C5	8.6×10^{14}	67	1.7	1.20	0.13	no
p	C40b	8.6×10^8	46	2.04	2.40	0.36	yes
p	C77	6.2×10^{15}	58	0.65	1.00	0.35	no

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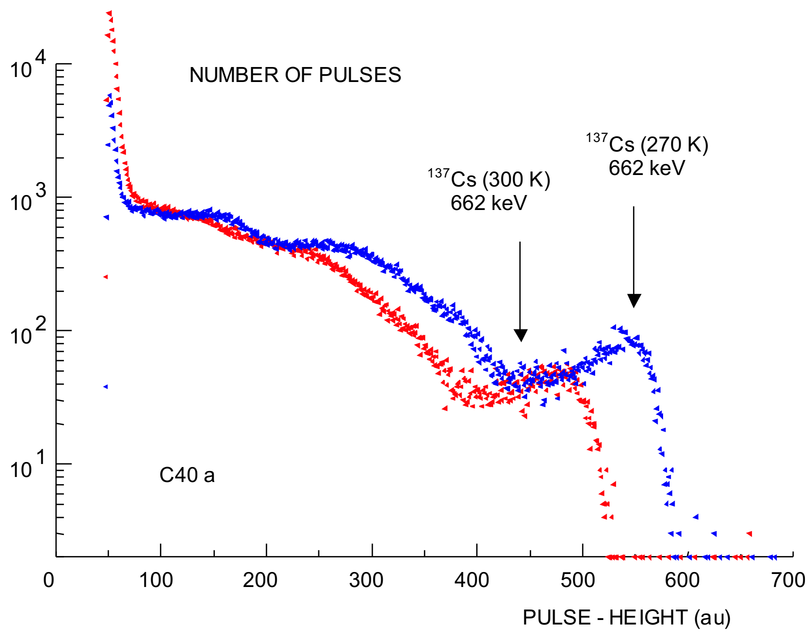

Fig. 1. Spectral analysis of radiation detector C 40a

drag (see Table 1), we find a good mutual correlation. Good detection performance was observed only on our samples with a high value of the phonon drag. High values of the phonon drag show that the interaction between optical phonons and holes is strong which indicates that the crystal lattice contains less defects and thus is more suitable for detection.

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