Spectrometric Characteristics of Scintillation Photodiode Detectors Based on CsI:Tl Crystals

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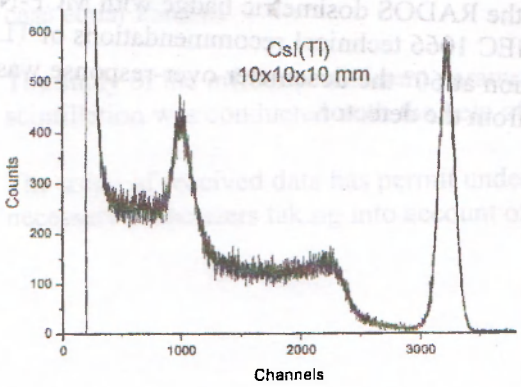
Recently the perceptible progress has been achieved in development of scintillation photodiode detectors. Improvements has been made in crystal growth as well as surface treatment of CsI:Tl crystal and packing the sample in assembly with photodiodes. Main recent results are presented in a table in comparison with known data [1, 2]. As a rule we used silicon PIN photodiodes, for instance Hamamatsu S3590-08.

Volume, cm^3	Energy threshold, keV	Energy resolution, %			Peak/valley ratio	Refs
		^{241}Am	^{137}Cs	^{60}Co	^{241}Am	
1	60	–	7.45	4.67	2.5	[1]
1	30	38	5.2	4.1	3.2	[2]
0.1	17	19.2			38	This work
1	25	35	4.7	3.8	4	

As it seen from the data of the table the energy threshold for detection of low energy photons by scintillation photodiode detectors is widened from 50 to 17 keV; very good energy resolution (19.2%) and the peak to valley ratio (38) are obtained for 59.6 keV (^{241}Am) γ-rays. Other interesting result is obtained for detection of 662 keV (^{137}Cs) γ-rays. A pulse-height spectrum for 1×1×1 cm^3 CsI:Tl crystal is presented on a figure. The energy resolution for this crystal is varied in interval from 4.7 to 4.8 %.



The obtained value R = 4.7 % is very close to theoretical limit R = 4.5 % which originated from Murray-Meyer theory based on non-proportionality of response. This theory predicts that photopeak is wide to high energy if the contribution of photo receiver to the R is small. The shape of photopeak on figure is fitted well by Caussian. It means that the contribution of non-proportionality to the R either is absent or is mach smaller then 4.5 %.

[1] B. Grinyov, V. Ryzhikov, J. Kim, M. Jae. Scintillator Crystals, Radiation Detectors & Instruments on Their Base. Ukraine, Kharkiv (2004)

[2] V. Semynozhenko, B. Grinyov, V. Nekrasov, et al. Nucl. Inst. Meth. Phys. Res. **A 537** (2005), 383