Absorber characterization
COMPASS thesis

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Contents

Chapter 1

Absorber characterization

We investigated luminescence and scintillation properties of the $Gd_3Al_2Ga_3O_{12}:Ce$ (GAGG) produced by *Furukawa* company. The GAGG crystal has the highest light yield among oxide crystal at room temperature [1] and fast decay time for the detection of radioactivity and in nuclear and particle physics experiments.
A list of the most important parameters for GAGG is reported in Table 1.1.

Some fundamental features of this crystal are that it has no intrinsic radioactivity and it is a non-hygroscopic material. This allows a better usage for experimentation with low risk of contamination from ambient.

The measurements have been carried out by illuminating the scintillation rod with a X-ray beam.
*Si*PM and electronic chain parameters was varied measuring the relative position of the photo-peak in the spectrum produced by the scintillator.

Density $[g/cm^3]$	Light yield [photon/MeV]	Decay time [ns]	Peak emission [nm]	Energy resolution [% @662 keV]	Hygroscopicity
6.63	57000	88 (91%) 258 (9%)	520	5.2	No

Table 1.1: Physical and scintillation properties of GAGG

1.1 Experimental set-up

Laboratory measurements have been carried out using a single rod made of GAGG produced by *Furukawa* company.
The rod has a square-base parallelepipoidale shape with a height of 30mm and a side of 3mm , thus their dimension results 2/3 lower to the one expected for the polarimeter bars ($\sim 10mm$).
To minimize the loss of photons during scintillation, the bar was *wrapped* with Teflon Fig 1.1, that has a high reflection coefficient for small incident angles.

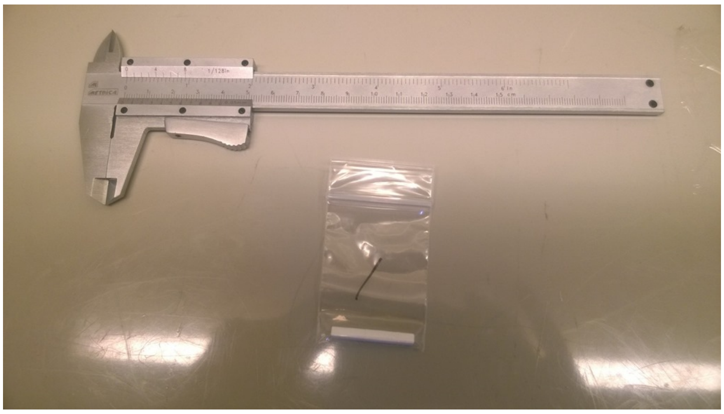

Figure 1.1: Scintillation rod made of GAGG wrapped with teflon

The rod has been placed over a single SiPM, model LCT4/9 produced by the Hamamatsu company.
Properties, CAD scheme and microscopic details of this SiPM are reported in Tab 1.2, Fig 1.2 and Fig 1.3 respectively.

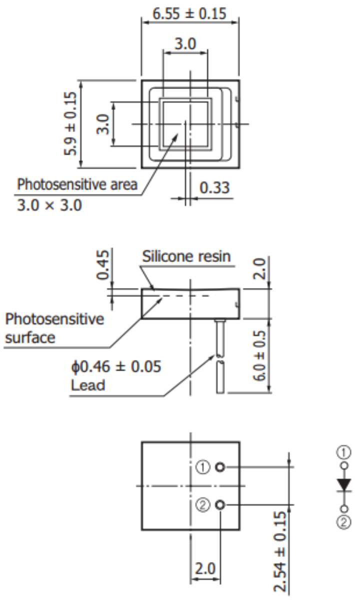

Figure 1.2: CAD scheme for LCT4/9

Cell pitch	$75 \mu m$
Device size	$3 \times 3 mm^2$
Microcells	1600
Surface coating	Silicone resin
Fill-factor	73%
Breakdown[1]	51.10 V

Table 1.2: Main physical features of the LCT/9

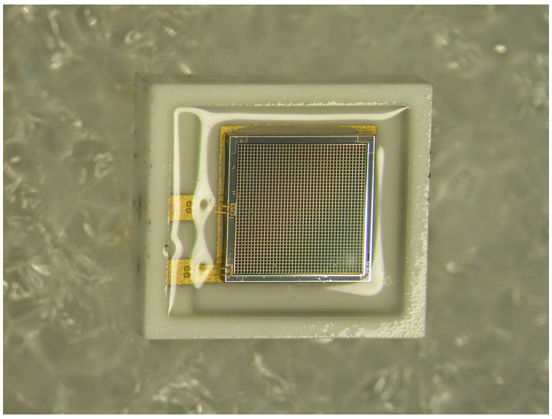

Figure 1.3: Image of LCT4/9 taken through a microscope.

This set of MPPCs produced by Hamamatsu, have an included proprietary circuit board with power supply for a direct hardware control from PC via USB connection (see Fig 1.4).
The C12332 is a simple evaluation starter kit for non-cooled MPPC. MPPC evaluation is possible by mounting an MPPC in the socket of the sensor circuit board. The power supply circuit board is equipped with the C11204-01, a high-accuracy, high-voltage power supply that provides the operating voltage from MPPC. It operates just by connecting to an extenal power supply ($\pm 5V$). It is also equipped with a USB interface that can be used to set the operating voltage and temperature compensation coefficient from a PC running the supplied sample software.
We used the power supply circuit board with serial number C12332 with nominal gain of 21 for LCT4/9.

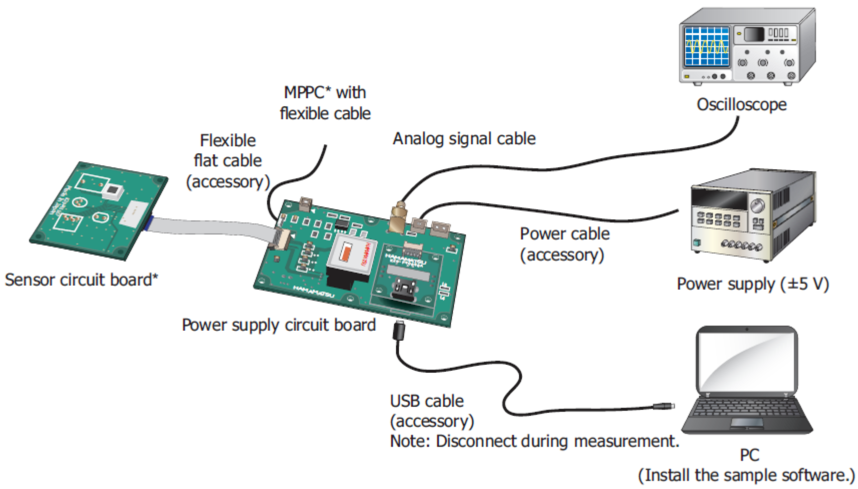

Figure 1.4: Connection example

1.2 Definition of the operative range

1.3 Circuit calibration with X-ray sources

1.4 Energy resolution measurement

Bibliography

[1] Hye-Lim Kim et al. Journal of Ceramic Processing Research. Vol. 16, No. 1, pp. 124-128, 2015