BrilLanCe® 380

It's what's inside that Counts!

Scintillation Material

BrilLanCe™380 [$LaBr_3(Ce)$] [1] is a transparent scintillator material that offers the best energy resolution, fast emission and excellent linearity. It has higher light output than NaI(Tl) and also better energy resolution.

The FWHM (full width at half maximum) for 1" diameter by 1" long, 2" diameter by 2" long and 3" diameter by 3" long crystals has been measured at 2.8%, 2.6% and 2.9% respectively. The energy spectrum for the 3" by 3" is shown in Figure 1. The material's superior energy resolution is most pronounced at energies above 100 keV when compared with NaI(Tl).

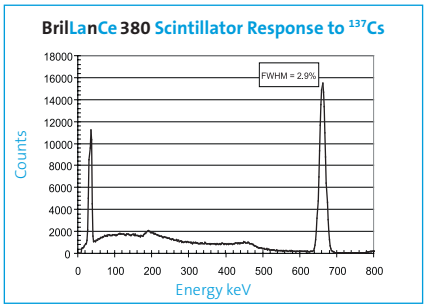

Figure 1. Pulse height spectrum

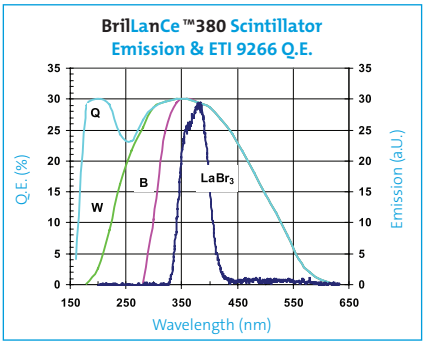

Figure 2. Scintillation emission spectrum of the BrilLanCe 380 crystal and Quantum Efficiency of a bialkali ETI9266 PMT with (B)Borosilicate, (W)UV glass, and (Q)Quartz face plates (Q.E. data courtesy of Electron Tubes, Inc.)

The emission of scintillation light (Figure 2) is well within the wavelength range of standard photomultiplier tubes (PMTs) with borosilicate glass face plates (Curve B), which makes these standard PMTs suitable.

The light yield as a function of temperature was measured with ^{137}Cs excitation at two amplifier shaping times of 1µs and 12µs. The temperature of the PMT was maintained constant while the temperature of the scintillator was varied from -65°C to +175°C. Results are shown in Figure 3. This data indicates that around room temperature from 0°C to +55°C the light output of the BrilLanCe 380 crystal changes less than 1%, and the light output changes less than 5% in the range of -65°C to +140°C.

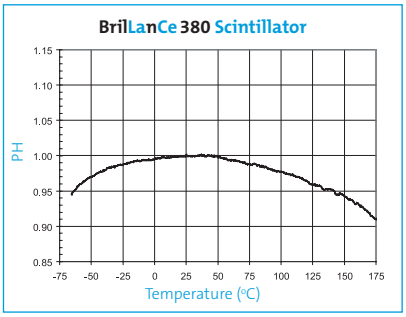

Figure 3. Temperature response. (The curve is for 12µs. The curve for 1µs is identical.)

Properties	
Density [g/cm³]	5.08
Melting point [K]	1116
Thermal expansion coefficient [10^{-6}/°C]	8 along C-axis
Cleavage plane	<100>
Hygroscopic	yes
Wavelength of emission max [nm]	380
Refractive index @ emission max.	~1.9
Primary decay time [µs]	0.016
Light yield [photons/keVγ]	63
Photoelectron yield [% of NaI(Tl)] (for γ-rays)	165

Refer to technical note **"BrilLanCe Scintillators Performance Summary"** for additional information on the following topics:

Energy Resolution versus Energy

Response versus Temperature

Response versus Rate

Coincidence Resolving Time

Background

Radiation Hardness

Mechanically Robust

Users with questions about application details or with any residual concerns about ruggedness are invited to contact our office.

SAINT-GOBAIN

SAINT-GOBAIN

USA

Saint-Gobain Crystals
17900 Great Lakes Parkway
Hiram, OH 44234
Tel: (440) 834-5600
Fax: (440) 834-7680

Europe

Saint-Gobain Crystals
104 Route de Larchant
BP 521
77794 Nemours Cedex, France
Tel: 33 (1) 64 45 10 10
Fax: 33 (1) 64 45 10 01

P.O. Box 3093
3760 DB Soest
The Netherlands
Tel: 31 35 60 29 700
Fax: 31 35 60 29 214

Japan

Saint-Gobain KK, Crystals Division
3-7, Kojimachi, Chiyoda-ku,
Tokyo 102-0083 Japan
Tel: 81 (0) 3 3263 0559
Fax: 81 (0) 3 5212 2196

China

Saint-Gobain (China) Investment Co, Ltd
15-01 CITIC Building
19 Jianguomenwai Ave.
Beijing 100004 China
Tel: 86 (0) 10 6513 0311
Fax: 86 (0) 10 6512 9843

India

Saint-Gobain Crystals and Detectors
Sy. No. 171/2, Maruthi Industrial Estate
Hoody Rajapalya, Whitefield Main Road
Bangalore 560048 India
Tel: 91 80 42468989
Fax: 91 80 28416501

www.crystals.saint-gobain.com

BrilLanCe™ 380 Scintillation Material

Absorption Efficiency of BrilLanCe 380 [$LaBr_3(Ce)$]

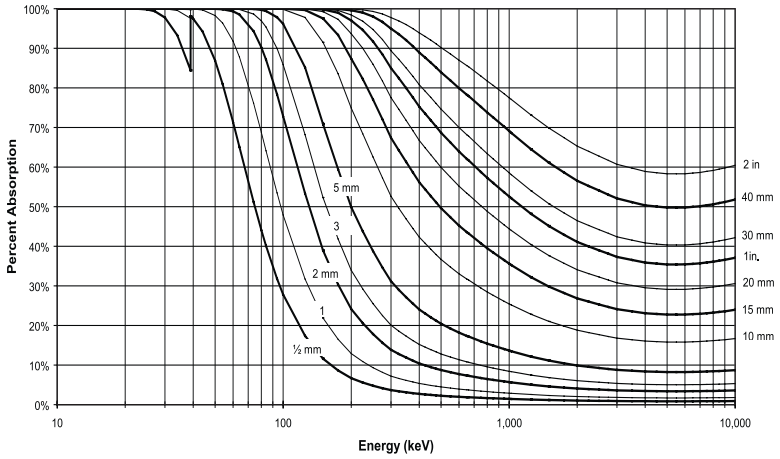

Figure 4. Gamma and X-ray absorption efficiency for various thicknesses of BrilLanCe 380 material. Data compiled by C. M. Rozsa (presented in Saint-Gobain Crystals' brochure "Efficiency for Selected Scintillators.")

Representative coincidence resolving times (CRT) are shown below for various sizes of BrilLanCe 350 and BrilLanCe 380 detectors. The data was taken using two Photonis XP20Y0 PMTs gated on 511keV from ^{22}Na. The PMT serving as the STOP channel was coupled to the crystal to be measured and the other PMT was coupled to a dedicated START crystal, a 4x4x5mm BrilLanCe 380 crystal. Figure 5a shows that BrilLanCe 380 detectors have somewhat better timing than BrilLanCe 350.

We also see the dependence on crystal size, slowing as crystals and light transit times become larger. Figure 5b shows the single channel CRT measured for a few geometries using a standard PMT with plano-plano face plate. This is an important point because it is possible to maintain the optimum performance of BrilLanCe crystals with standard PMTs . Note that the CRT does depend critically on the PMT; for example. the XP2060 38mm PMT gives much poorer performance than the larger PMTs.[2]

Figure 5a. Coincidence Resolving Time (CRT) of BrilLanCe detectors as a function of the crystals' longest dimension measured with fast timing PMTs that have plano-concave face plates.

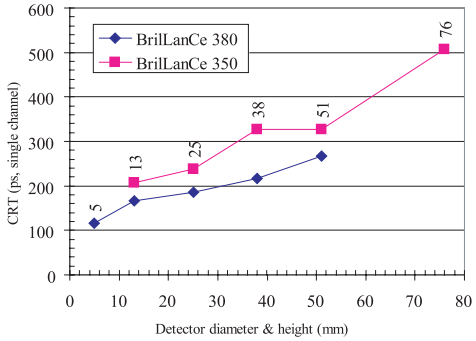

Figure 5b. Timing with BrilLanCe 380 Integrated Detector

Size (mm)*	CRT** (ns)	PMT Size (mm)	PMT*** Type
25x25	1.08	38	XP2060
38x38	0.36	51	R6231
51x51	0.45	56	XP5500
76x76	0.49	76	XP5300

* Diameter and length or right cylinder crystal.

** CRT is the single channel Coincidence Resolving Time.

*** These are standard PMTs with plano-plano phot cathode face plates.

[1] E. V. D. van Loef, P. Dorenbos , C. W. E. van Eijk, H.U. Gudel, K.W. Kraemer; *Applied Physics Letters*, 79, pp 1573-1575 (2001).

[2] Refer to Saint-Gobain Technical Note " BrilLanCe Scintillators: Performance Summary."

**This original patent was granted to Stichting Voor de Technische Wetenschappen. Inventors are P. Dorenbos, C. W. E. van Eijk, H.U. Gudel, K.W. Kraemer, E. V. D. van Loef*

Technology is licensed to Saint-Gobain Cristaux & Detecteurs.

Protected under patents US7067816B2,US7250609B2,EP1257612B1,EP1516078B1,ZL03813659.7,UA75066C2*

BrilLanCe®: *is a registered trademark of Saint-Gobain Ceramics & Plastics, Inc.*

Manufacturer reserves the right to alter specifications.

(06-14)