CsI(pure) Cesium Iodide Scintillation Material

Cesium Iodide is a material with high γ-ray stopping power due to its relative high density and atomic number. Undoped CsI, being an intrinsic scintillator, has very different scintillation properties from the more widely used CsI(Tl) or CsI(Na) activated by Tl or Na respectively.

Undoped CsI is mainly used in physics experiments because of its combination of fast timing and relatively high density. Its scintillation is heavily quenched at room temperature, and cooling improves the light output.

CsI is slightly hygroscopic. Contact with water and high humidity should be avoided.

CsI(pure) Emission –

Undoped CsI, also called CsI(pure) has an emission maximum at 315nm (see Figure 1) with an intensity one tenth that of the doped CsI crystals. The light output, though, is heavily quenched at room temperature, and cooling to -77°C would give ten times higher light output (see Figure 2).

The photoelectron yield, in combination with bialkali photocathodes, amounts to about 400 phe/MeV @25°C. For small crystals, an energy resolution of 17 to 18% can be expected for 662 keV.

Because the emission wavelength is in the UV, the optical windows, surface conditions and optical coupling should be carefully selected in order to avoid losing light. A standard glass photomultiplier tube (PMT) can be used, but they are clearly not optimum. PMTs are better suited than photodiodes as a readout for this crystals.

The scintillation emissions properties are highly affected by the presence of trace impurities in quantities below ppm in the crystal and by growth process. Thus, a high quality process is mandatory to get a good, reliable performance.

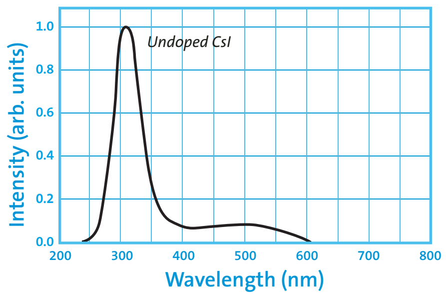

Figure 1. Scintillation emission spectrum of CsI(pure)

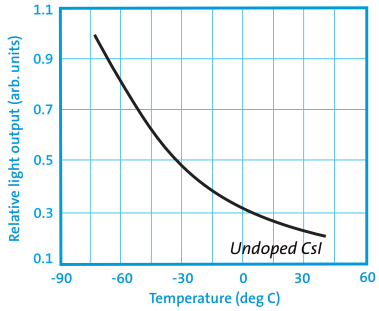

Figure 2. Relative light output as a function of temperature for CsI(pure)

Properties	
Density [g/cm³]	4.51
Melting point [K]	894
Thermal expansion coefficient [C^{-1}]	54×10^{-6}
Cleavage plane	none
Hardness (Mho)	2
Hygroscopic	slightly
Wavelength of emission max [nm]	315
Lower wavelength cutoff [nm]	260
Refractive index @ emission max.	1.95
Primary decay time [ns]	16
Light yield [photons/keVγ]	CsI(pure) 2 CsI(Tl) 54
Photoelectron yield [% of NaI(Tl)] (for γ-rays)	CsI(pure) 4-6 CsI(Tl) 45

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Timing with CsI(pure) –

CsI has a short decay time of 16ns which represents 70 to 80% of the light output in good quality large pieces. There is also a much slower component with a decay time of 1000ns, a peak emission wavelength around 500nm. This component represents 20% or so of the total light. Crystals quality is often characterized by the ratio of the fast component to total light output.

Although cooling CsI(pure) increases the total light yield, it also increases the slow component.

CsI(pure) is the cheapest of the crystals allowing fast timing, and is available in large sizes – 80x80x300mm.

Radiation Hardness –

Measurements indicate that undoped CsI is much more radiation hard than doped CsI and can recover from radiation damage after some time. For doses up to 1000 Gray (10^5 rads), no severe radiation damage has been observed.

Manufacturer reserves the right to alter specifications.