$CdWO_4$
Cadmium Tungstate Scintillation Material

Cadmium tungstate is a high density, high Z scintillator with relatively high light yield. The emission maximum is at 475 nm, and the total light output is 12 to 15 photons/keV). The light yield relative to NaI(Tl) on a bialkali PMT is 30 to 50%.

The intensity of the scintillation emission of $CdWO_4$ as a function of the temperature is shown in Figure 2 (irradiation with γ-rays). At room temperature (25°C), the curve is relatively flat (-0.1%/°C) which can be important for some applications. For further technical information, see Reference 2.

The intensity of the scintillation emission of $CdWO_4$ as a function of wavelength is shown in Figure 1. This distribution is a good match to photodiodes. CT scanners for high and low energies have been built with $CdWO_4$. A long decay time of 14000 nanoseconds is not a drawback for CT scanners or other systems that operate with a current mode readout.

Furthermore, $CdWO_4$ has a low afterglow. This is important in preventing glare and streaking in the generated images and allows for faster processing.

$CdWO_4$ cleaves readily along one plane. This is an asset that is used in manufacturing to produce polished surfaces. Cleaved $CdWO_4$ has been fabricated in lengths up to 7 inches.

The high density and stopping power of $CdWO_4$ make it an efficient absorber. It takes only 3mm to stop up to 150keV photons. (See table on back.)

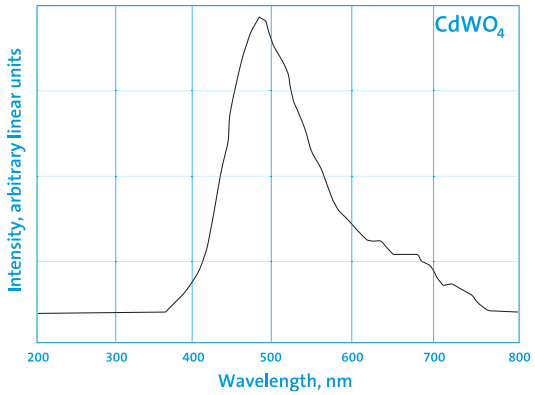

Figure 1. Scintillation emission spectrum of $CdWO_4$

Properties	
Density [g/cm^3]	7.9
Melting point [K]	1598
Thermal expansion coefficient [C^{-1}]	10.2x10^{-6}
Cleavage plane	<010>
Hardness (Mho)	4 - 4.5
Hygroscopic	no
Wavelength of emission max [nm]	475
Lower wavelength cutoff [nm]	330
Refractive index @ emission max.	2.2 - 2.3
Primary decay time [ns]	14000
Light yield [photons/keVγ]	12 - 15
Photoelectron yield [% of NaI(Tl)] (for γ-rays)	30 - 50

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Figure 2 shows the light output of $CdWO_4$ as a function of temperature. The curve is relatively flat (-0.1%/°C) near room temperature. This is an important benefit for many applications. (For further information, see Reference 2.)

$CdWO_4$ shows a very good radiation resistance: for doses of 10^4 Gray (10^6 rad) γ-rays, the optical transmission of the crystal decreases less than 15%. For β-particles, this effect is even smaller: less than 6% for 10^5 Gray (10^7 rad).

$CdWO_4$ has very little ^{228}Th and ^{226}Ra contamination and is suitable for low activity counting applications. (See Reference 1.)

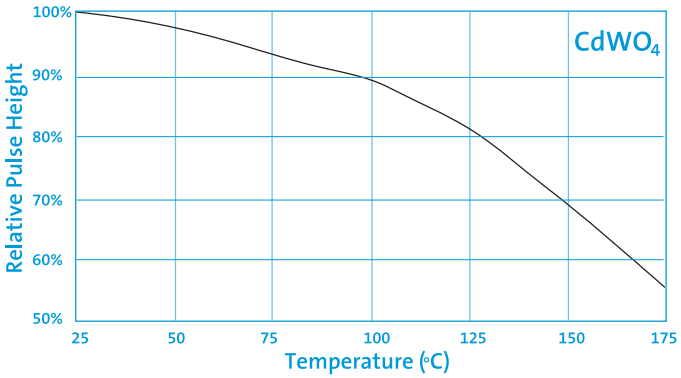

Figure 2. Temperature dependence of the scintillation light output of $CdWO_4$

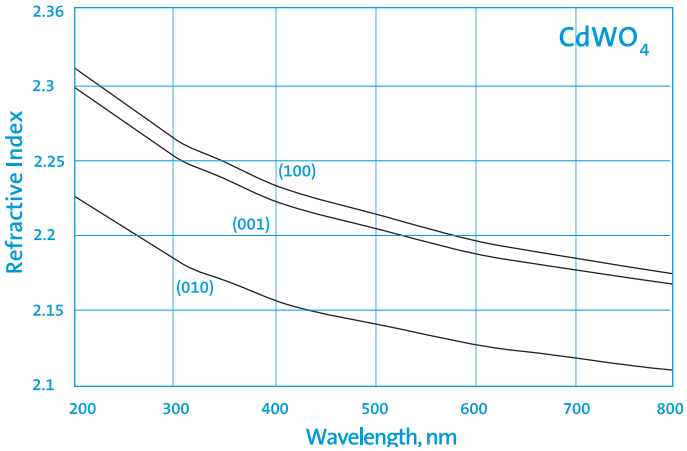

Figure 3. Refractive index at emission maximum

Material	K-edge keV	40keV mm	60keV mm	80keV mm	100keV mm	300keV mm	600keV mm
NaI	33.2	0.43	1.3	2.7	4.9	49.2	99.2
CsI	33.2	0.29	0.8	1.8	3.3	36.5	79.3
$CdWO_4$	69.5	0.33	0.9	0.5	0.9	12.6	35.9
BGO	90.5	0.38	1.1	2.2	1.1	13.3	37.8
LSO	63.3	0.55	1.6	0.7	1.3	16.0	40.9
LYSO	63.3	0.58	1.65	0.8	1.4	17.3	43.2

This table shows the thickness of material, in mm. required to absorb 95% of the noted X-ray energies

References:

1. *Nuclear Instruments and Methods*, A369(1996) 164-168.
2. *IEEE NS*, Volume 41, No. 4, August 1994.

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