

YAP:Ce

A Fast Inorganic Scintillation Material

General description

YAP:Ce — Yttrium Aluminum Oxide Perovskite doped with Cerium (chemical formula $YAlO_3:Ce$) — is a non-hygroscopic, glasslike, inorganic scintillator with a high density, but a relatively low effective atomic number. The wavelength of maximum emission is 350nm, the decay time is short, 27ns, and the light output is typically 40% of that of NaI(Tl).

The fast decay time and relatively high light output make it very good for high count rate and good timing applications. Note that in Fig. 1 the threshold is near 5 keV.

The non-hygroscopic nature of the crystal permits the use of very thin entrance windows. This suggests α and β ray detection applications. It can replace $CaF_2(Eu)$ in those cases for which a faster phoswich is needed.

YAP:Ce has good mechanical properties. It is very hard and can be easily polished to optical quality. It can be segmented into arrays for imaging applications. [See R. Pani, et al, *NIMPR*, A348 (1994) 551-558 (an investigation of imaging with position sensitive PMTs), and A. DelGuerra, et al, *IEEE-NSS and MIC Proceedings*, 1995 (PET study)]. With the fast decay constant of YAP:Ce, there is the potential for data rates of up to 10 times faster than NaI(Tl) or BGO.

Another beneficial property of YAP:Ce is that the rate of change of light output with temperature is small — 0.01%/°C (C.Rozsa, et al, *IEEE NSS, N20-21*, 1999). This makes it useful in downhole logging applications and in high temperature industrial processes.

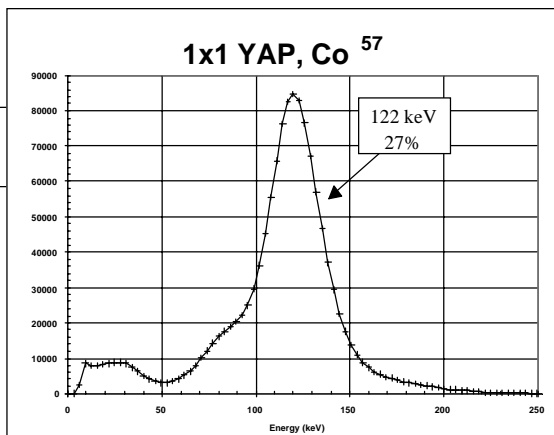


Fig. 1. Co^{57} spectrum with 1x1" YAP and bialkali PMT

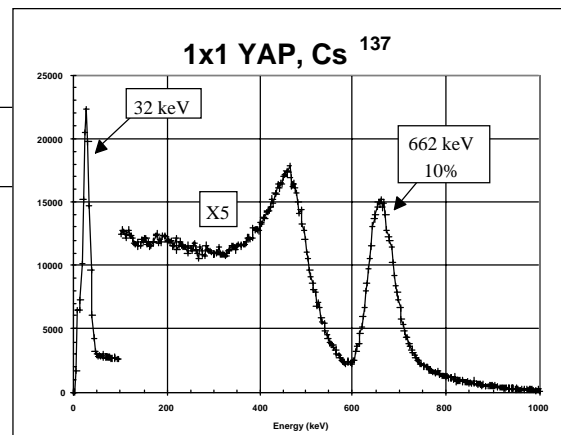


Fig. 2. Cs^{137} spectrum with 1 x 1" YAP and bialkali PMT

Comparison of YAP:Ce, NaI(Tl), and BGO

	YAP:Ce	NaI(Tl)	BGO
Density [g/cm ³]	5.55	3.67	7.13
Effective Atomic Number	36	50	83
Hardness (Mho)	8.5	2	5
Hygroscopic	no	very	no
Wavelength of emission maximum [nm]	350	415	480
Refractive index at emission maximum	1.94	1.85	2.15
Decay time [ns]	27	230	300/60
Relative light output	40	100	20
Light output, photons per MeV	18,000	38,000	8,500



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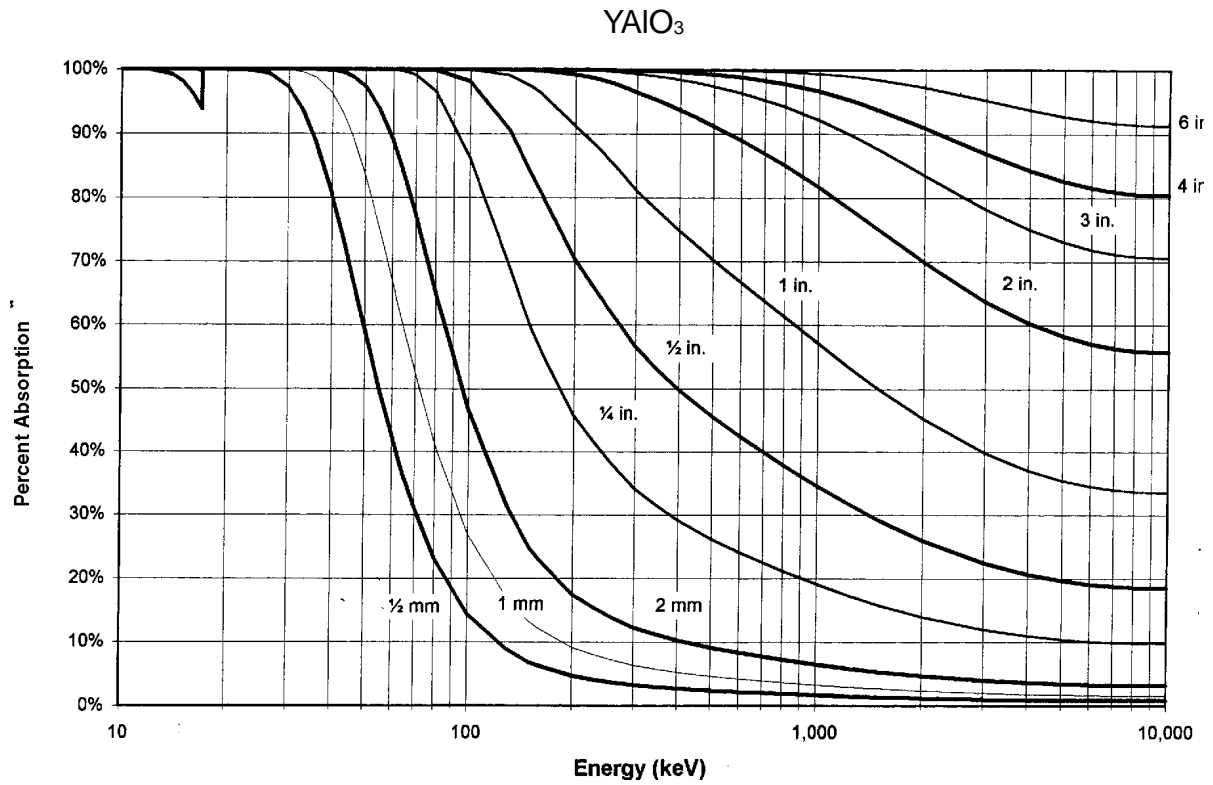


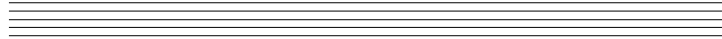
Fig.3. Absorption Efficiency of YAP
 Data compiled by C. M. Rozsa (presented in Bicron brochure "Efficiency for Selected Scintillators", ©1996 SGIC, Inc.)

The data presented are believed to be correct but are not guaranteed to be so.

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