

LiCAF

for Neutron Detection



Eu or Ce doped LiCaAlF₆ (*Ce:LiCAF, **Eu:LiCAF)

are novel thermal-neutron scintillators.

*T. Yanagida et al., Opt. Mater., 32, 311 (2009).

**T. Yanagida et al., Opt. Mater., 33, 413 (2011).

Specific Features of LiCAF

- n/γ discrimination
- Low γ sensitivity
- PSD compatible (Ce:LiCAF)
- Non-hygroscopic
- Large size available
- Transparent
- High light yield (Eu:LiCAF)

Applications

- ³He alternative detectors for:
 - Homeland security
 - Survey meter
 - Neutron Diffraction
- Neutron imaging devices

Available Size of LiCAF



Disk (4" dia. x 10 mmt)

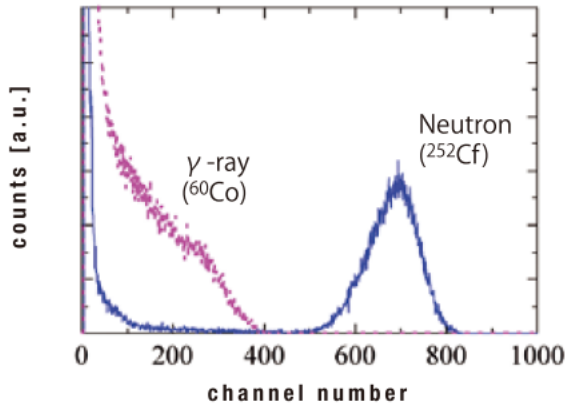


Array (2 × 2 × 4 mm³, 20 × 20 pixels)

Available in various sizes, please contact us by e-mail.
(ff@tokuyama.co.jp)

Crystals for your future

Ce:LiCAF



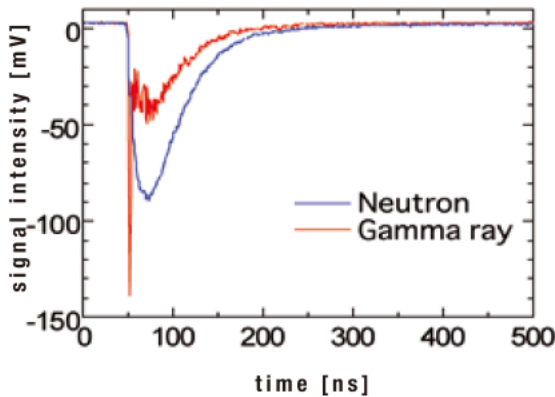
Low γ sensitivity and sufficient α/β ratio of Ce:LiCAF allows simple pulse height discrimination to reduce the γ background.

Fast response meets the requirement of high count rate operation and/or timing resolution.

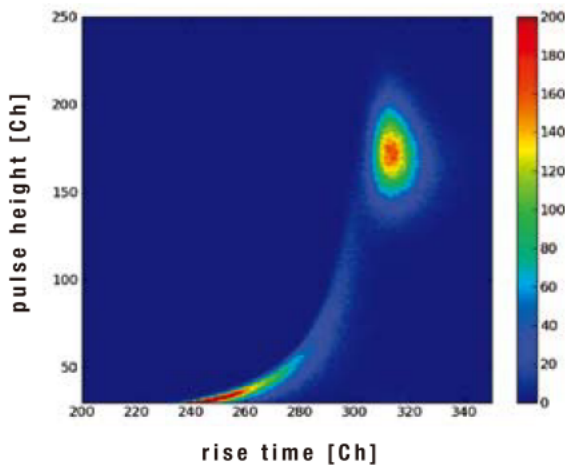
High transparency of the crystal makes possible a detector not only for thermal neutrons but also for epithermal neutron by the use of a thick scintillator.

Source : "Thermal neutron detection properties of Cerium doped LiCaAlF₆ single crystals", J. Iwanowska, et al., Nucl. Instr. and Meth. A, in press, doi:10.1016/j.nima.2010.09.182 (2011)

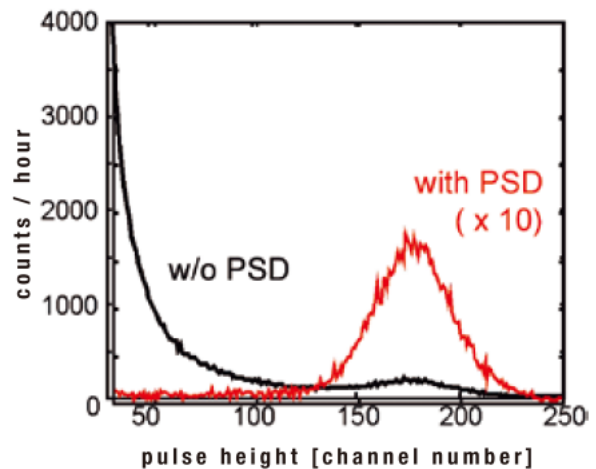
Gamma Suppression by Pulse Shape Discrimination



The pulse height spectra are separated by the pulse shape discrimination using the rise time of the integrated signal pulse. In the separated neutron spectrum, the γ -ray events were effectively suppressed without the loss of neutron events. The pulse shape discrimination was confirmed to be useful to use the Ce:LiCAF neutron scintillators under the condition where massive high-energy γ -rays exist.



Two-dimensional plot of pulse height versus rise time

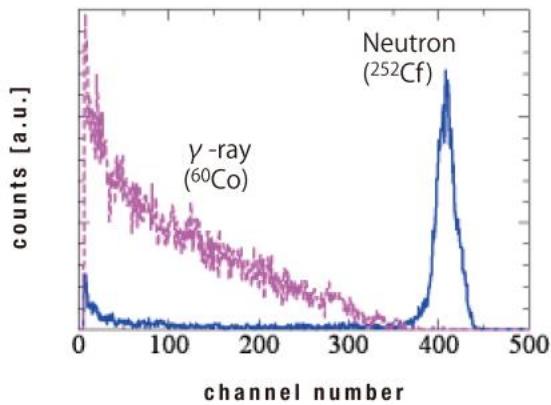


Pulse Height Spectra Under Strong γ Field

Source: "Neutron-gamma discrimination based on pulse shape discrimination in a Ce:LiCaAlF₆ scintillator"

A. Yamazaki, K. Watanabe, et al., Nucl. Instr. and Meth. A, 652 (2011) 435-438, doi:10.1016/j.nima.2011.02.064 (2011).

Eu:LiCAF



Eu:LiCAF, which possesses very bright scintillation at PMT-friendly wavelengths and is non-hygroscopic, is most suitable for neutron monitoring applications.

Furthermore, a phoswich-type detector consisting of Eu:LiCAF and gamma-sensitive scintillator provides excellent n/γ discrimination.

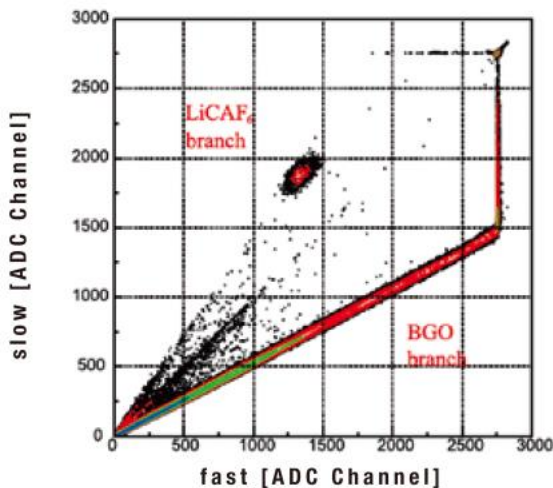
Source : "Basic study of Europium doped LiCaAlF₆ scintillator and its capability for thermal neutron imaging application", T. Yanagida, et al., Opt. Mater. ,33, 1243-1247 (2011).

Phoswich Detector for Neutron Astrophysics

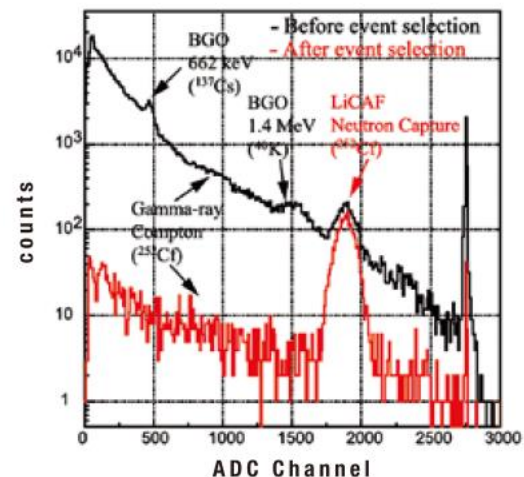


Eu:LiCAF was used for PoGoLite (Polarized Gamma-ray Observer) project with the aim to measure polarization of soft gamma rays. Since neutrons are most significant background, Eu:LiCAF scintillator was equipped to measure the neutron flux.

Phoswich detector consisting of Eu:LiCAF and BGO demonstrated excellent n/γ discrimination during ground testing and this detector was used in the pathfinder flight of PoGoLite experiment with a large Swedish balloon which was launched from Esrange Space Center. Atmospheric neutrons were successfully observed in July, 2011.



"fast"- "slow" diagram for ²⁵²Cf and ¹³⁷Cs.



Neutron events selection by phoswich detector.

Source : "A Thermal-Neutron Detector with a Phoswich System of LiCaAlF₆ and BGO Crystal Scintillators onboard PoGoLite", H. Takahashi et al., IEEE NSS MIC Conference record, 32-37 (2011).

Physical and Scintillation Properties of LiCAF

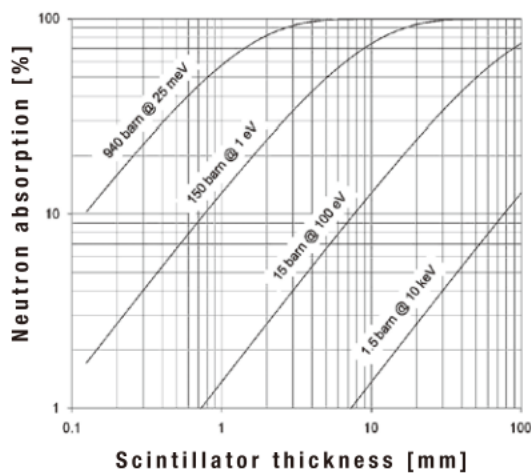
^6Li content : 9.1×10^{21} atoms/cm³

Density : 2.99 g/cm³

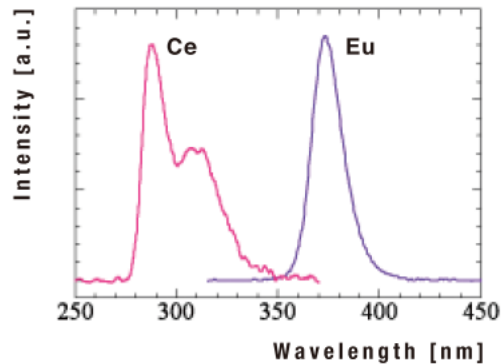
Effective Z : 15

	(Ce:LiCAF)	(Eu:LiCAF)
Light yield (photons/neutron)	~5,000	~40,000
Decay constant (nsec)	40	1,600
Luminescence wavelength (nm)	280 - 320	360 - 390
Transparency (at 10 mm thickness)	> 90%	> 90%

Values are not for specifications



Neutron Absorption of LiCAF



Luminescence spectra of LiCAF