Inradoptics

Chemical Formula:	$C_{14}H_{12}$
Crystal Symmetry:	**monoclinic**
Optical Symmetry:	**biaxial**
Class:	$P2_1/c$

Scintinel™

Stilbene Single Crystals

1" and 2" diameter stilbene cylinders

OVERVIEW

Crystalline stilbene is an organic scintillator used for radiation detection and is well-suited for discrimination between fast neutrons and a gamma-ray background. A fast neutron is one with kinetic energy above approximately 1 MeV. Fast neutron counting, spectroscopy, and imaging have applications in medicine, industry, research, defense, and homeland security.

Inrad Optics produces stilbene using a proprietary low-temperature solution growth technology. This method yields high-quality, low-stress material. All stilbene crystal growth, fabrication, and polishing is performed at our Northvale, NJ facility, ensuring complete traceability and satisfaction with every SCINTINEL™ crystal shipped.

SHAPES, SIZES, AND PACKAGING

Inrad Optics can fabricate stilbene into a variety of geometries as large as 4", including cylinders, disks, cubes, and plates. The stilbene material is polished and beveled to customer specifications.

Right cylinders with 1" diameter and 1" length are available as a standard item. Stilbene cylinders can be packaged in a canister for coupling to a photomultiplier tube.

HANDLING STILBENE

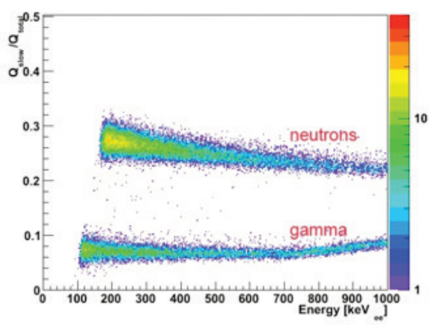
Stilbene can be handled in a similar manner as other crystalline materials. Allow stilbene to equilibrate to room temperature. Do not place stilbene directly in contact against materials with high thermal conductivity (such as metals). Avoid thermal shock and temperature gradients within the crystal. Small stilbene parts can be safely

Features	Advantages of SCINTINEL™
Direct detection of fast neutrons	• Neutrons do not need to be moderated to lower energies. • Measurements can take advantage of the low background, long attenuation length, and minimal number of benign sources of fast neutrons.
Excellent discrimination between neutrons and gamma rays	• Facilitates counting fast neutrons without false positives from gamma rays. • Permits use of lower energy thresholds.
Solid, non-hygroscopic, not flammable, not hazardous	• Unpackaged stilbene is stable. • Avoids the transportation, storage, and handling concerns of many liquid organic scintillators.

heated and cooled at rates of 10 °C/minute. Silicone grease may be used to achieve an optical contact. Clean stilbene by gently wiping with a soft, dry cloth. Do not use solvents as these will attack the surface.

PULSE SHAPE DISCRIMINATION

The scintillation light pulse emitted from stilbene consists of both a prompt and a delayed fluorescence. The fraction of light resulting from the slow component often depends on the type of particle interacting with the crystal. Pulse shape discrimination (PSD) methods exploit this effect to separate events arising from neutrons and gamma rays. The pulse shape discrimination pattern of Inrad Optics stilbene shows exceptional neutron-gamma separation, with a figure of merit of 4.7 measured near 500 keVee. The figure of merit is calculated as the separation between gamma ray and neutron peaks divided by the sum of the full-widths at half maximum of the relevant peaks. The energy scale was calibrated using the Compton edge of 137Cs and is presented in units of keVee (keV electron equivalent) to account for the particle-dependent variation in light output per keV deposited in the scintillator.



Pulse shape discrimination data from Inrad Optics stilbene (^{252}Cf source). Data courtesy N. Zaitseva, LLNL.

Details regarding experimental methods for pulse shape discrimination with stilbene can be found in: Zaitseva, N. et al., *IEEE Trans. Nucl. Sci.*, vol. 58, no.6, pp.3411-3420, 2011.

Scintillation Peak	390 nm
Melting Point	124 °C
Refractive Indices (at 589 nm)	1.703, 1.724, 1.844
Density	1.15 g/cm^3

Inrad Optics acknowledges the participation and support of this project by the U.S. Department of Homeland Security (DHS) Domestic Nuclear Detection Office (DNDO), under contract HSHQDC-12-C-00020. This acknowledgement is not an express or implied endorsement.