DETEC
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Scintillating Products

DETEC-Europe
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Inorganic scintillators

- Alkali-halide Crystals
- Oxyde-based Crystals

Organic scintillators

- p-Terphenyl ($C_{18}H_{14}$)
- Anthracene ($C_{14}H_{10}$)
- Stilbene ($C_{14}H_{12}$)
- Plastic (Polystyrene)

Types of products

- Scintillators
- Encapsulated Scintillators
- Detector Scintillators
- Complete Assemblies

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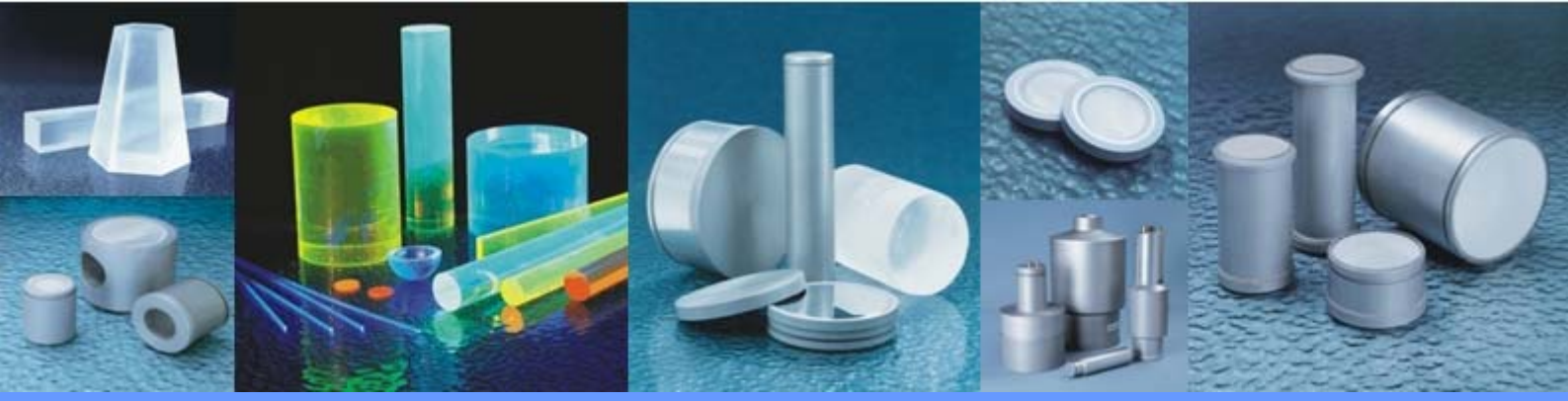

Presentation

Inorganic Scintillators 1

Inorganic Scintillators 2

Organic Scintillators 1

Organic Scintillators 2

Products

Accessories

Inorganic Scintillators

Alkali-halide Crystals
- NaI(Tl)
- CsI(Tl)
- CsI(Na, CO_3)
- CsI undoped
- LiI(Eu)

Oxyde-based Crystals
- CWO
- GSO
- BGO
- PWO

Other
- ZnSe(Te)

Organic Scintillators

- p-Terphenyl ($C_{18}H_{14}$)
- Anthracene ($C_{14}H_{10}$)
- Stilbene ($C_{14}H_{12}$)
- Plastic (Polystyrene)

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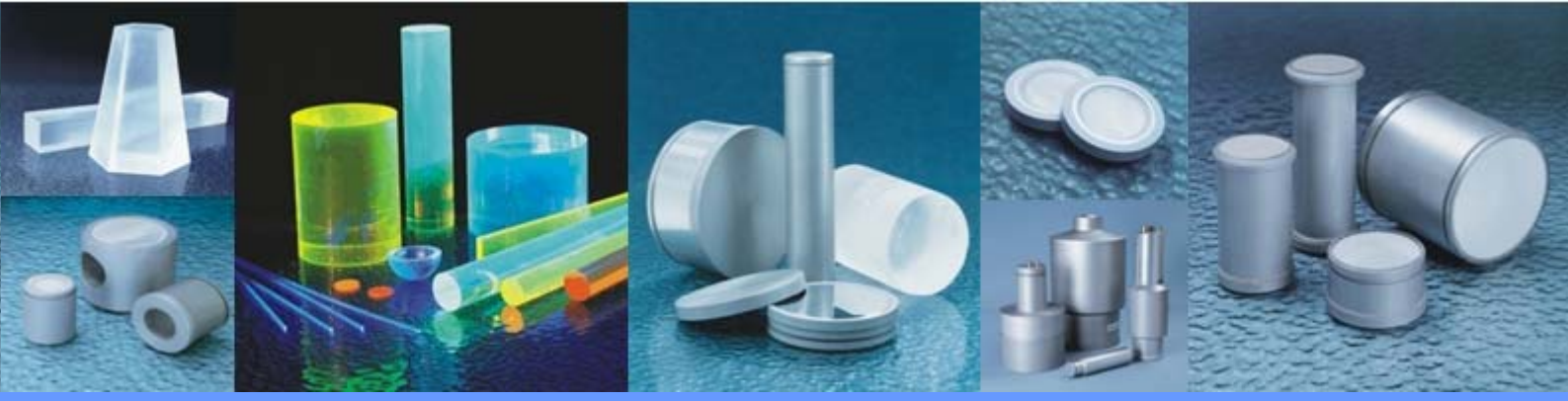

Type of Products

Scintillating products are customizable

Scintillators:

Raw Material
+ Polished (optional)

Encapsulated:

Scintillator encapsulated in:

- Al housing (default), or
- Stainless steel housing

Detectors:

Scintillator with PMT
+ µ-metal shielding (optional)

Complete Assemblies (Detector)

+ Voltage divider
+ Preamplifier
+ Connectors

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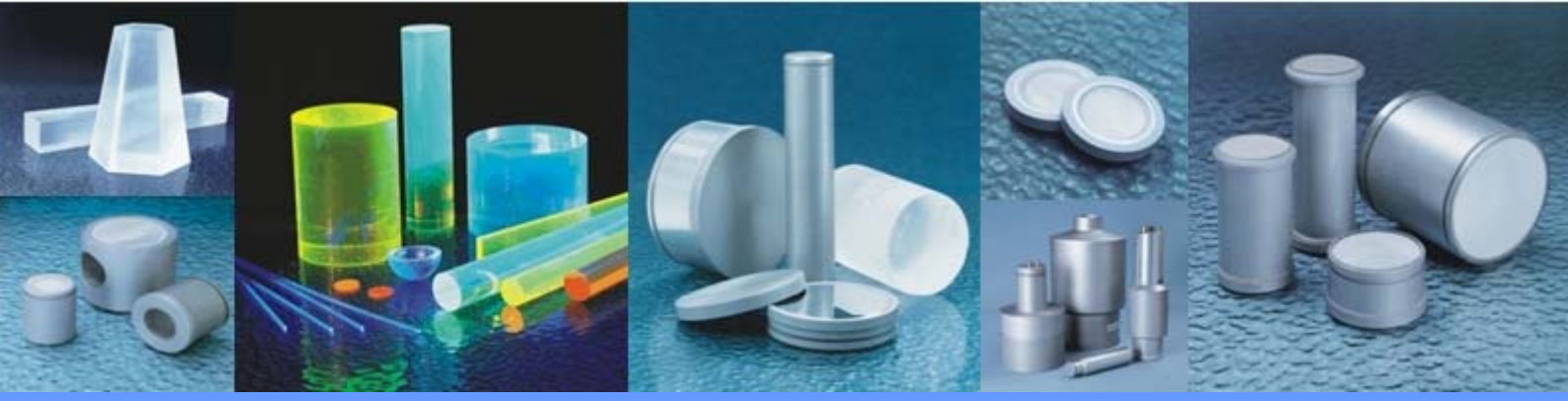

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NaI(Tl)

The use of NaI(Tl) crystals in sealed units is counterbalanced by the fact that they have the greatest light output among all the scintillators and a convenient emission range matching the maximum efficiency of photomultipliers with bialkali photocatodes. Moreover, large-size NaI(Tl) crystals can be produced at low cost.

Undoped CsI

The decay time is ~10 ns. Undoped CsI can be used for experiments in medium and high-energy physics.

CsI(Tl)

Since the maximum light emission is at 550 nm, it can be associated with Si photodiodes, thus reducing significantly the size of the detection system, without HV power supply, and without sensitivity to magnetic fields.

$CsI(CO_3)$

$CsI(CO_3)$ has a light output of 60% compared to NaI(Tl). Decay time ranges from 1.4 to 3.4 ms depending on the dopant concentration. These characteristics allow $CsI(CO_3)$ to be used in combination with other scintillators in phoswich detectors. $CsI(CO_3)$ has an afterglow of 0.05% after 5 ms.

CsI(Na)

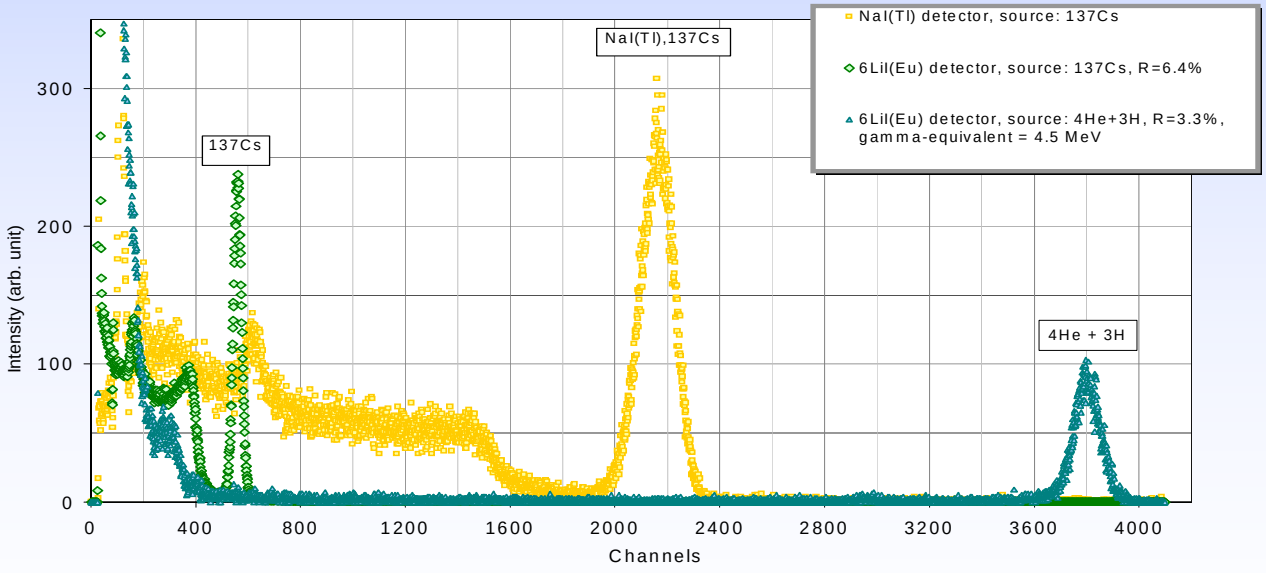
CsI(Na) is a good alternative to NaI(Tl) in many standard applications : it has a high light output (85% of that of NaI(Tl)), about the same light emission wavelength and hygroscopy is substantially lower.

^{6}LiF(Eu)

The absorption of thermal neutrons in Li-based crystals is based on the following reaction: $^6Li+n \rightarrow {}^3He+H+Q$

^{6}Li is submitted to special export regulations.

Distribution spectra of pulse amplitudes from detectors based on LiI(Eu) of dimensions 12.5 dia. x 8 mm and NaI(Tl) under excitation by gamma-radiation of 137Cs and thermal neutrons from Pu-Be



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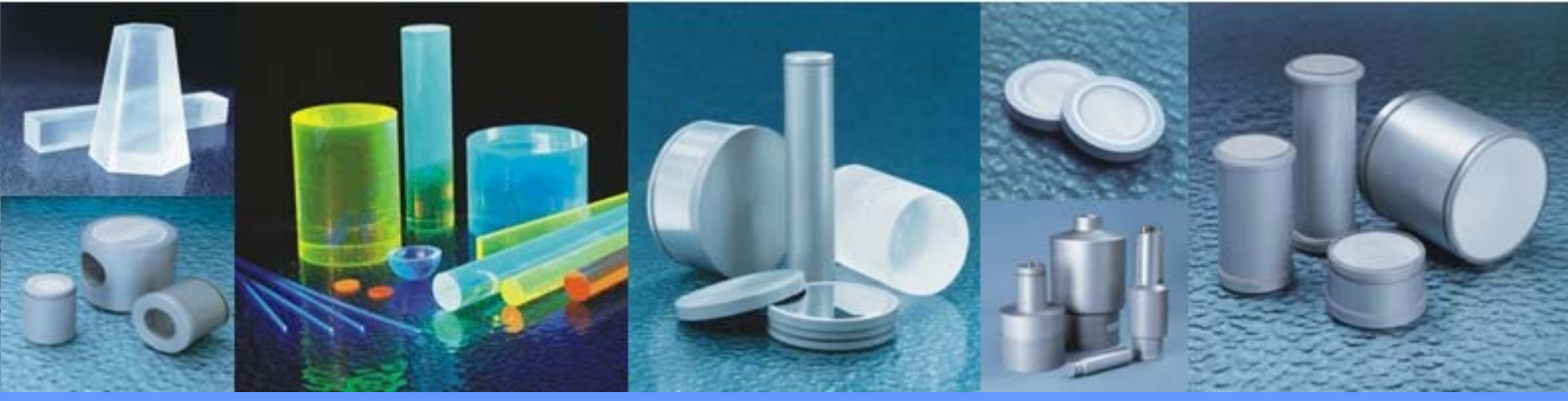

Physical Properties of Alkali Halide Scintillators

	NaI(Tl)	CsI(Na)	CsI(Tl)	CsI	CsI (CO_3)	^{6}LiI(Eu)
Density (g/cm^3)	3.67	4.51	4.51	4.51	4.51	4.08
Melting point (K)	924	894	894	894	894	719
Thermal expansion coef-ficient (10^{-6}xK^{-1})	47	49	49	49	49	40
Cleavage plane	<100>	none	none	none	none	<100>
Hardness (Mho)	2	2	2	2	2	2
Hygroscopic	yes	yes	slightly	slightly	yes	very
Maximum emission (nm)	415	420	550	310	405	470
Refractive index	1.85	1.84	1.79	1.95	1.84	1.96
Light Yield (% of NaI)	100	85	45	5-6	60	30-35
Primary decay time (ms)	0.23	0.63	1	0.01	2	1.4
Afterglow after 6 ms (%)	0	0.3-5	0.5-5	0.1	0	0

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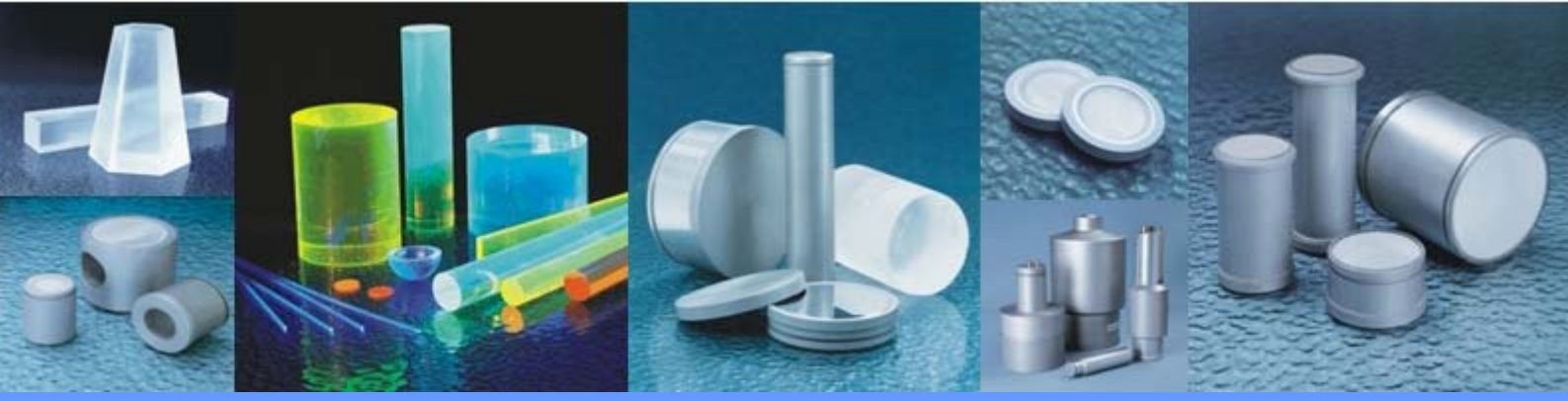

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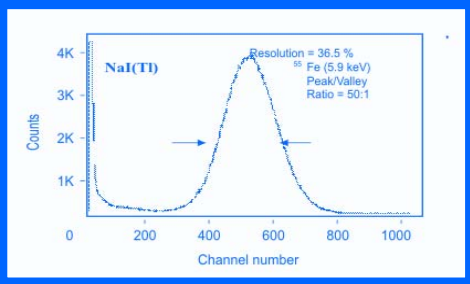
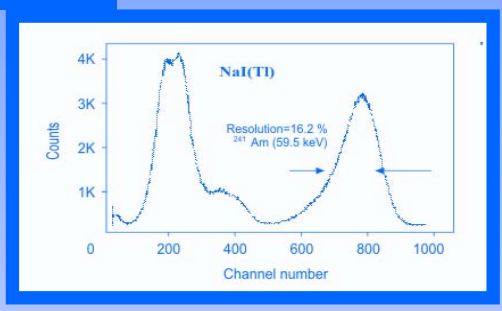
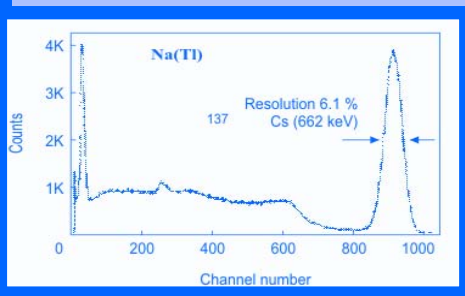
Some Responses of Alkali Halide Scintillators

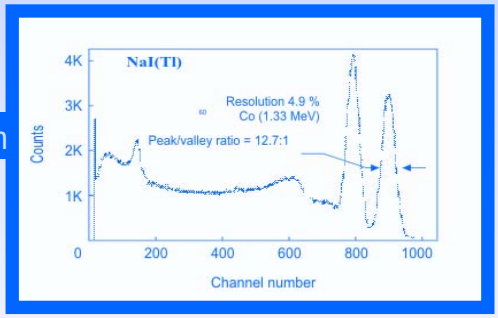


NaI(Tl) Ø 20 x 2 mm with Be window

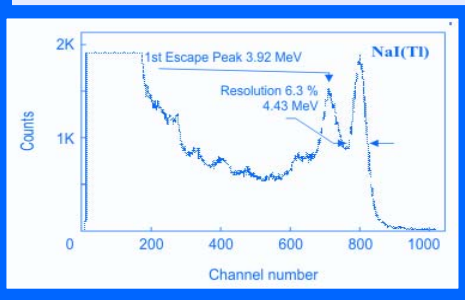




NaI(Tl) Ø 40 x 40 mm



NaI(Tl) Ø 63 x 63 mm



NaI(Tl) Ø 150 x 100 mm

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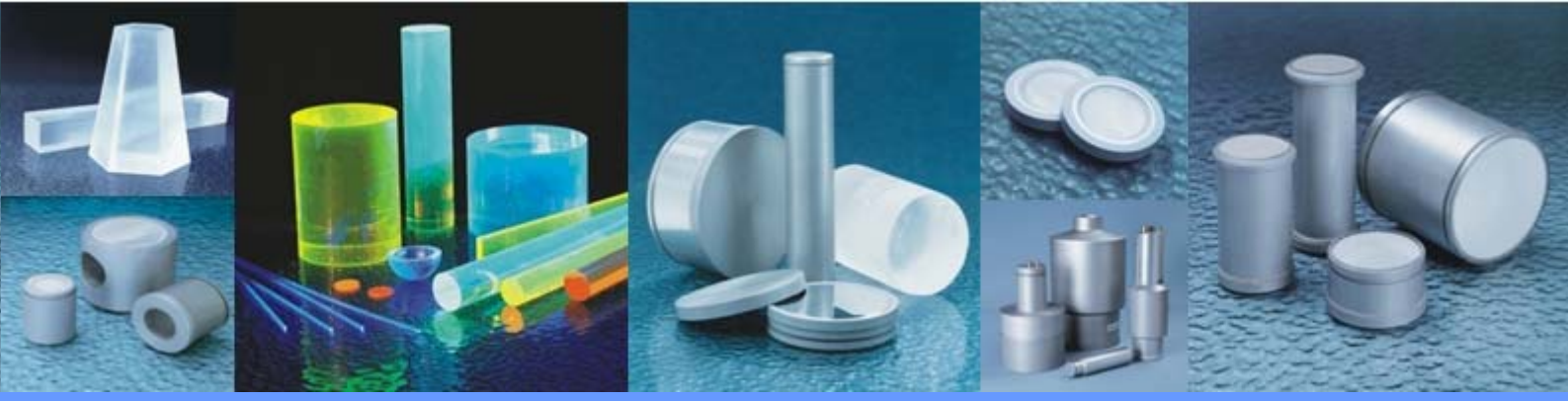

Our Oxide-based Scintillator production includes : Cadmium Tungstate $CdWO_4$ (CWO), Gadolinium Silicate Gd_2SiO_5:Ce (GSO), Bismuth Germanate $Bi_4Ge_3O_{12}$ (BGO), Lead Tungstate $PbWO_4$ (PWO).

CWO

Cadmium Tungstate $CdWO_4$ (CWO), due to its low intrinsic background and afterglow together with reasonably high light yield, is one of the most promising materials for Spectrometry and Computed Tomography.

GSO

Gadolinium Silicate (GSO) is a fast scintillator. It is a very promising candidate for gamma-ray spectrometry below 1 MeV and for Computed Tomography. Also, it exhib- its good temperature stability.

BGO

Bismuth Germanate (BGO) is one of the most widely used oxide scintillators, espe- cially for the detection of high energy gamma-rays. It exhibits good energy resolution in the range of 0.5 to 20 MeV and relatively short decay time.

PWO

Lead tungstate $PbWO_4$ (PWO) is a new ‘heavy’ and ‘fast’ scintillator mainly dedicated for High Energy Physics. It has the shortest radiation length and Moliere radius, satis- factory light yield and high radiation stability.

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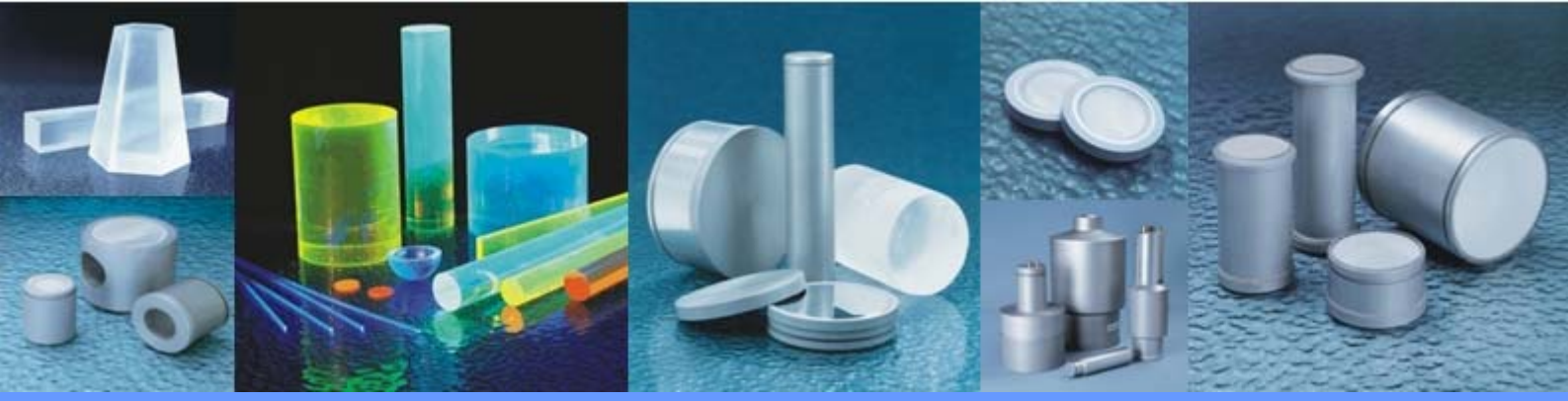

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Physical Properties of Oxide-based Scintillators and ZnSe(Te)

Properties	CWO	GSO	BGO	PWO	ZnSe(Te)
Effective Atomic Number	66	59	75	73	33
Density, g/cm^3	7.99	6.71	7.13	8.28	5.42
Radiation length, cm	1.06	1.38	1.1	0.85	-
Refractive index	2.25	1.85	2.15	2.2	2.6
Hygroscopy	No	No	No	No	No
Maximum luminescence, nm	490	440	480	430-520	610-640
Decay time, ns	5,000	30/60	300	2/10/30	10^3-$30x10^3$
Light output, Photon/MeV	15,000	9,500	8,000	200	80,000
Radiation stability, rad	10^7	10^8	10^6	10^7	10^8
Afterglow after 5 (20) ms, %	0.05 (≤0.01)	-	0.005	-	< 0.05

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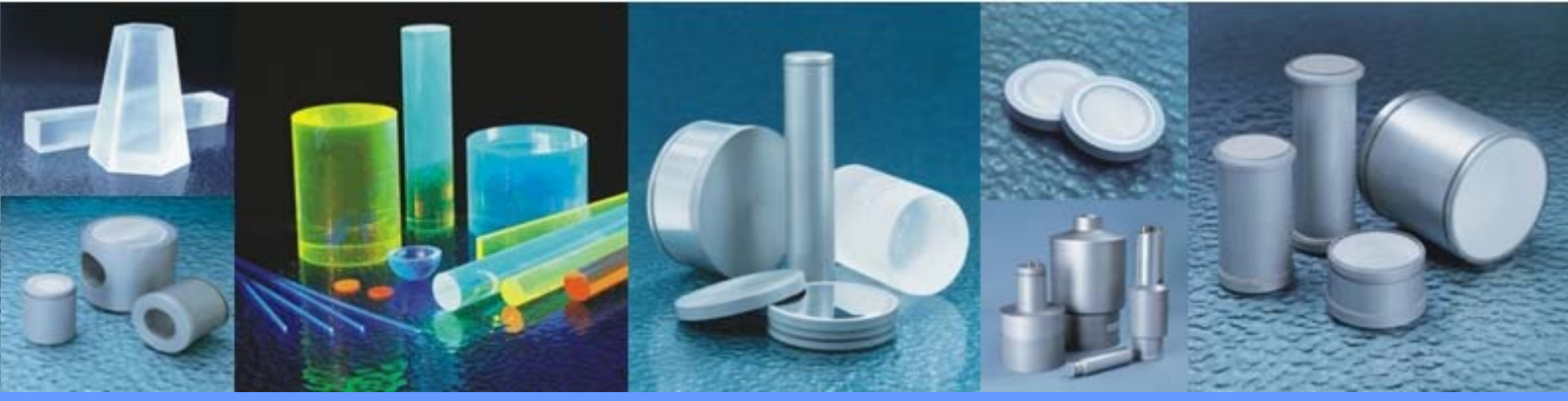
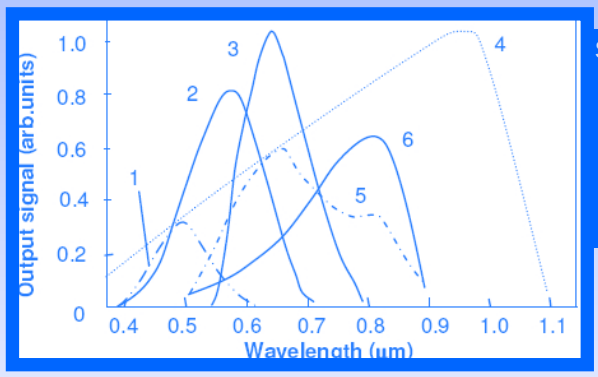


ZnSe(Te)

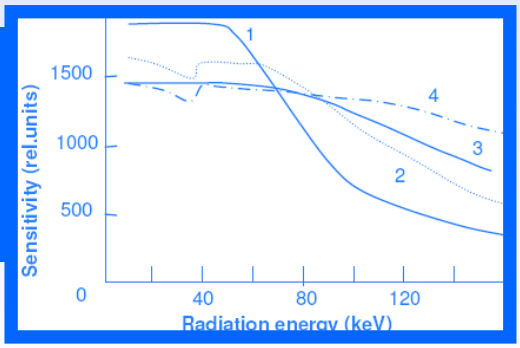
It exhibits a relatively high light output at longer wavelengths (red) with no afterglow and high thermal and radiation stability. Coupled to Si-photodiodes, it can be used for X-ray imaging or Tomography, X-ray (200 keV) and alpha/beta spectrometry.



Spectral-luminescent characteristics of scintillators:
1. CdWO4;
2. CsI(Tl);
3. ZnSe(Te);
4. sensitivity of Si photodiode;
5. sensitivity pZnTe-nCdSe (Ne=2.4x10^{17} cm^{-3}) photodiode;
6. sensitivity pZnTe-nCdSe (Ne=2.4x10^{15} cm^{-3}) photodiode.

X-ray sensitivity of scintillators CsI(Tl) and ZnSe(Te) as function of radiation energy

1. ZnSe(Te,O), thickness dsc=0.7mm;
2. CsI(Tl), dsc=0.7 mm;
3. ZnSe(Te,O), dsc=4.0 mm;
4. CsI(Tl), dsc=4.0 mm.



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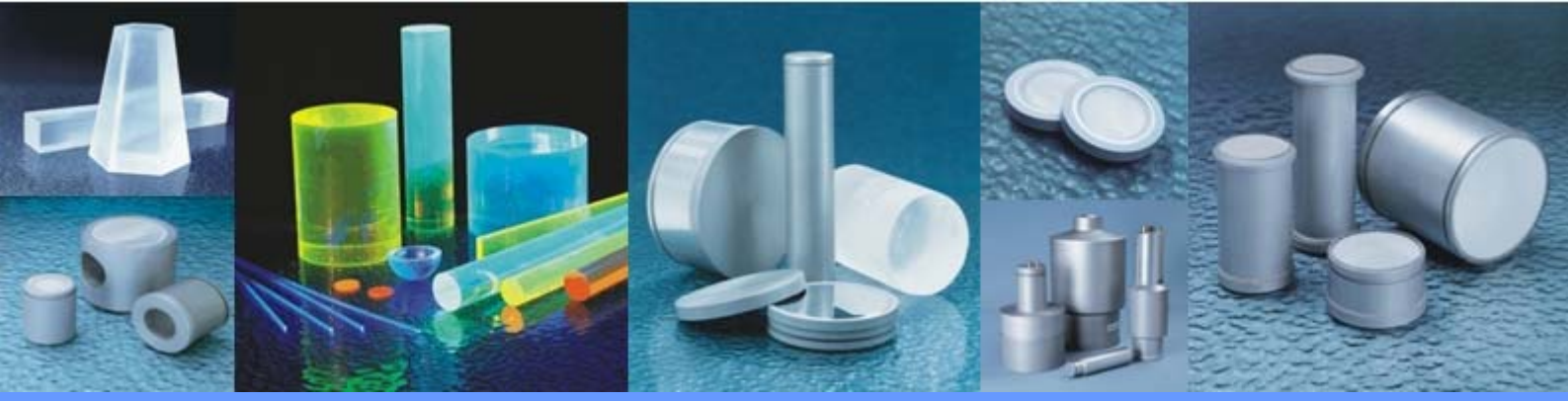

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Organic molecular crystals

Due to their low Atomic Number, organic materials are well suited for the detection of charged particles as back-scattering effects are minimized. The high concentration of hydrogen atoms permits the detection of fast neutrons. Scintillators are non-hygroscopic and provide fast responses.

Anthracene ($C_{14}H_{10}$)
Anthracene is mainly used for the detection of beta radiation both in counting and spectroscopy modes. It presents a strong light output anisotropy.

Stilbene($C_{14}H_{12}$)
Mainly used for fast neutron detection and spectroscopy. Pulse rise-time analysis techniques can be applied to discriminate between neutrons and gamma radiation background or between alpha and beta particles.

Doped p-terphenyl ($C_{18}H_{14}$)
Doped p-terphenyl can be used for the detection and spectroscopy of alpha and beta particles and neutrons. It exhibits a short decay time ($\tau \approx 3$-4 ns) and a temperature-independent scintillation yield within a wide temperature range (- 80°C +150°C).

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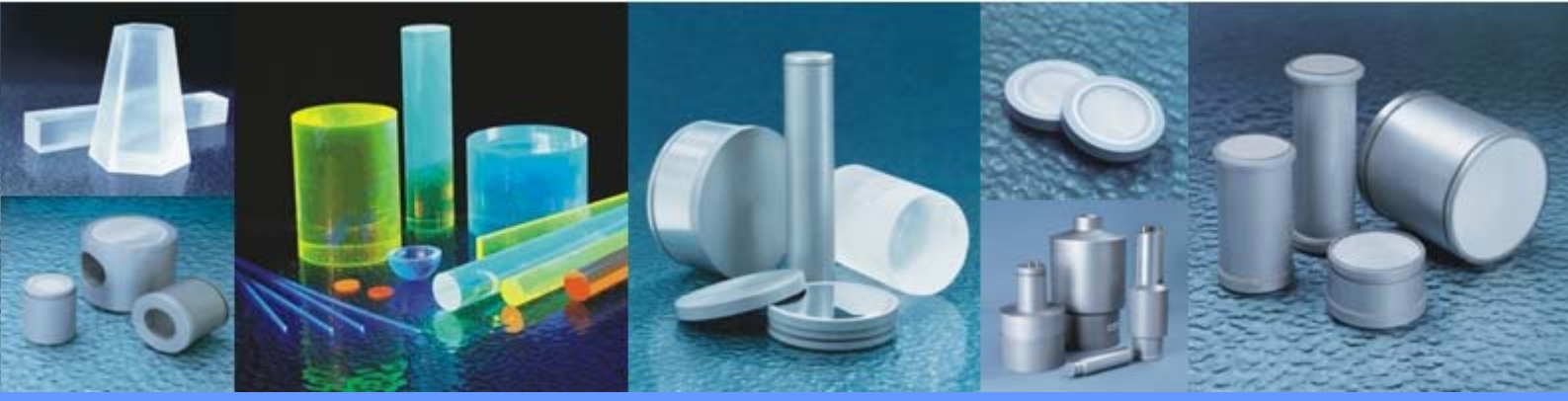

Physical Properties of Organic Scintillators

Properties	Anthracene ($C_{14}H_{10}$)	Stilbene ($C_{14}H_{12}$)	p-terphenyl ($C_{18}H_{14}$)
Molecular weight	178	180	230
Density, g/cm^3	1.25	1.22	1.23
H/C ratio	0.714	0.857	0.778
Melting point, °C	216	124	214
Luminescence max., nm	445	390	420
Refractive index	1.62	1.64	1.65
Light output, Photon/MeV	20,000	14,000	27,000
Decay time, ns	30	3.5	3.7
Hygroscopy	No	No	No
Radiation stability, rad	2 10^6	4 10^6	4.5 10^6

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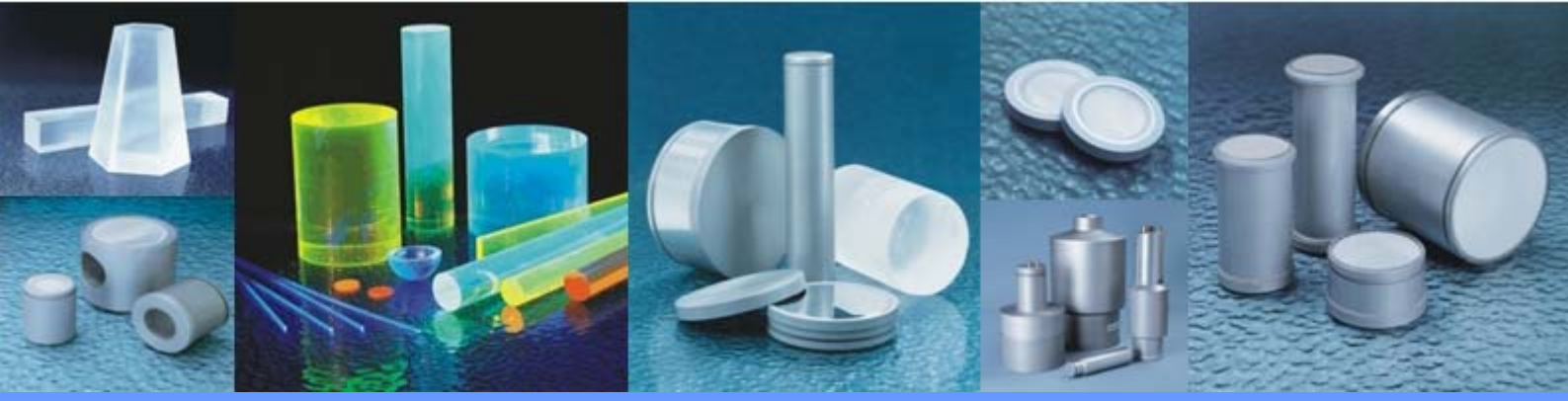

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Plastic scintillators are based on luminophors (luminescent additives) embedded in transparent polymer blocks (polystyrene (PST)). Characteristics of plastic scintillation materials such as light output wavelength, scintillation yield, transparency, decay time, radiation resistance can easily be modified by changing dopant compositions inside the PST block.

Polystyrene based scintillator

Scintillators based on polystyrene are used to detect alpha, beta, gamma radiation and fast neutrons. Most pastic scintillators are prepared by bulk thermal polymerization in aluminium (size up to 3.5 m) or glass cast and by pressure molding technique.

The following products are available :

- fast plastic scintillation material: decay time from 0.9 to 0.5 ns, light output 55 % of anthracene ;
- plastic scintillation material having the slow decay component: decay time from 300 to 400 ns, light output 45 % of anthracene;
- radiation hard plastics (UPS-92RH)
- scintillation material for dosimetry, tissue equivalent.
- scintillation polystyrene containing soluted organic compounds of heavy elements (Pb -12%, Sn -10%).

The table on the next page displays the technical characteristics of some of our plastic materials.
Please ask for special specifications you are looking for.

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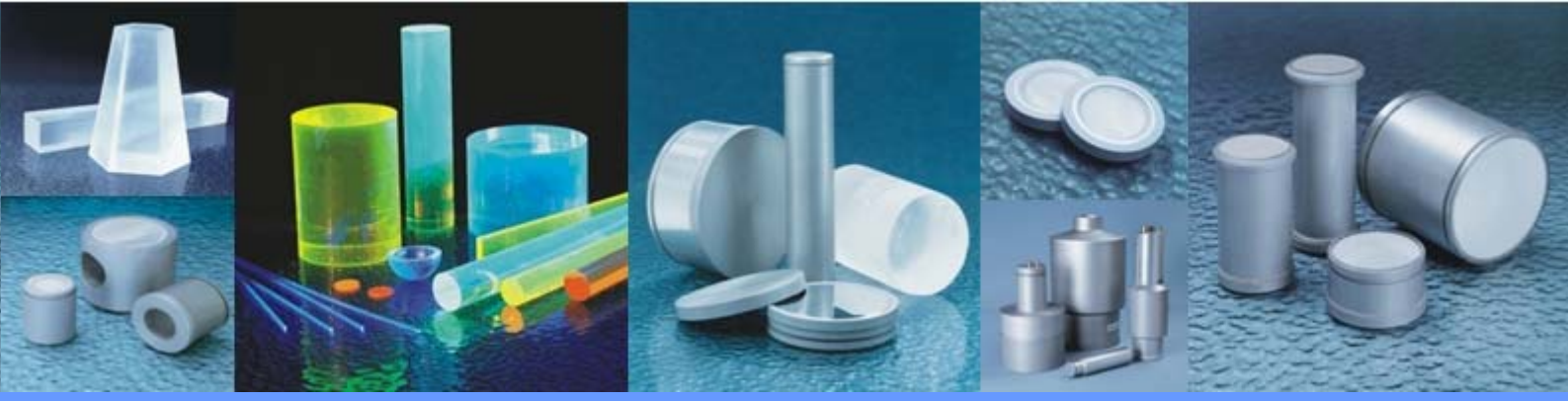

Physical Properties of Plastic Scintillators

Names / Properties	PS-923A	PS-923D	PS-91F	PS-92S	PS-98GC	PS-99RH	PS-02E	PS-96M	PS-99TE	PS-974
Light output, % anthracene	56	56	39-45	44	57	46	55	55	45	53
Rise time, ns	0.9	0.9	0.7	0.9	0.9	0.9	1.0	1.0	0.9	0.9
Decay time, ns	3.3	3.3	1.8	250-450	3.3	3.5	3.5	3.5	3.3	-
Bulk attenuation length (BAL), cm	250-450	350-550	-	150-180	150-250	110	30-60	30-60	70-100	250-400
Technical attenuation length (TAL), cm	150-250	200-300	-	150-180	150-250	110	30-60	30-60	70-100	250-400
Wavelength of max. emission, nm	418	418	390	380	418	418	418	418	425	480*
Dimensions achievable, m	3.5	3.5	1	1	2.5	3.5	0.44	0.44	0.05	3.5
Applications	General purpose		Fast counting	Phoswich detectors for dE/dx studies	Particle calorimetry: + Tiles and bars of particle calorimeters	-	+ Strips for neutrino detectors	+Tiles of particle calorimeters	X-ray dosimetry	Operation with fiber shifters
Analogs	BC-408 BC-416		BC-404	BC-444	BC-408 SCSN-81T		PolHiTech	PSM-115	BC-470	BC-428
Properties	High light yield, high transpar., large size	PS-923A + high surface & technical attenuation length	Short decay time	Long decay time	Perfect glass surface	High radiation hardness	Economy	Economy	Tissue equivalent	Green emitting scintillator

BAL: typical e^{-1} attenuation length of 200cm length sample, edges polished, with He-Cd laser (at λ=441nm)
TAL: typical e^{-1} attenuation length of 1x20x200 cm length sample, all sides polished, measured with Sr-90.

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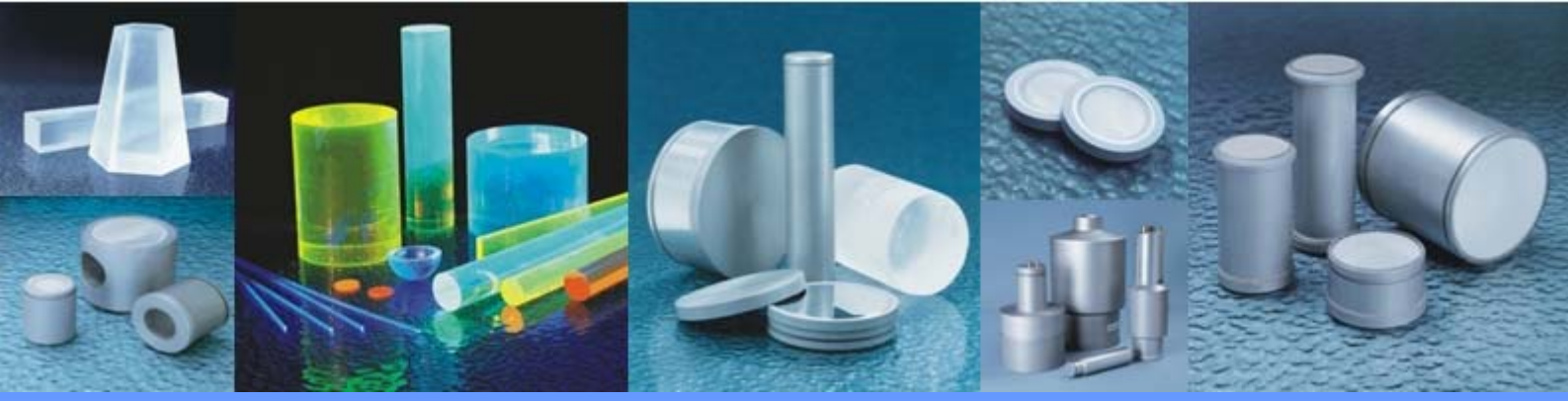

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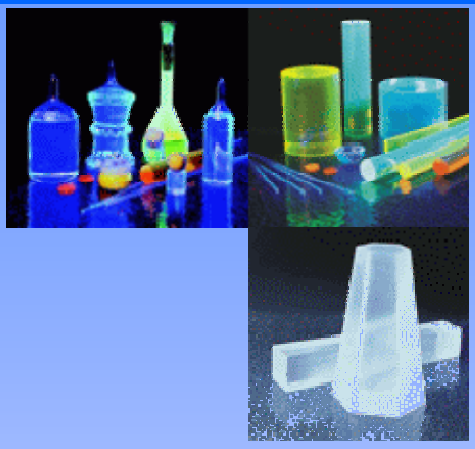


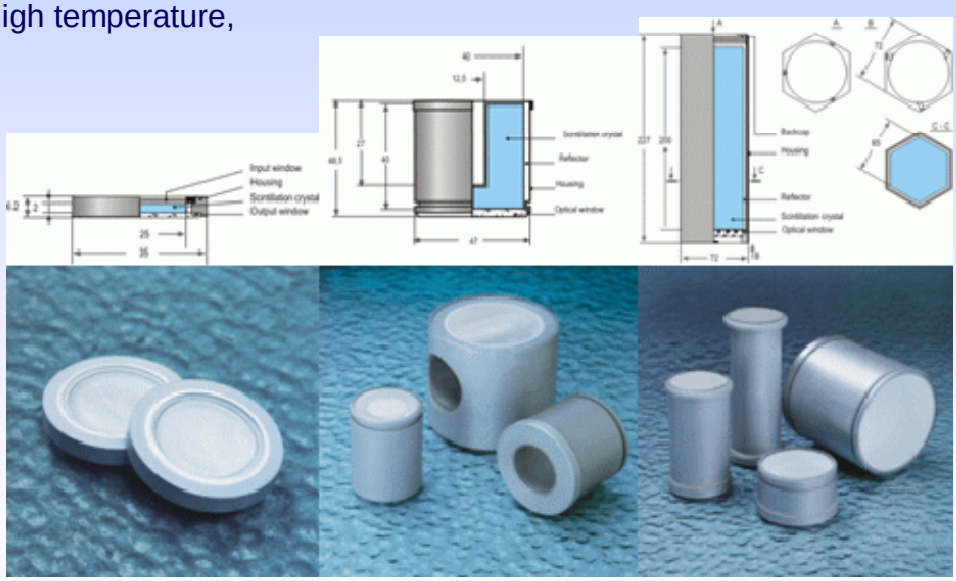
Scintillating Material Type S

Raw material or polished

Encapsulated Scintillator Type E

E-type
for Standard Applications : aluminium housing with protective glass window

E/R-type
for Ruggedized applications : stainless steel housing with quartz window for harsh environments — high temperature, strong vibrations.



Detailed specifications upon request

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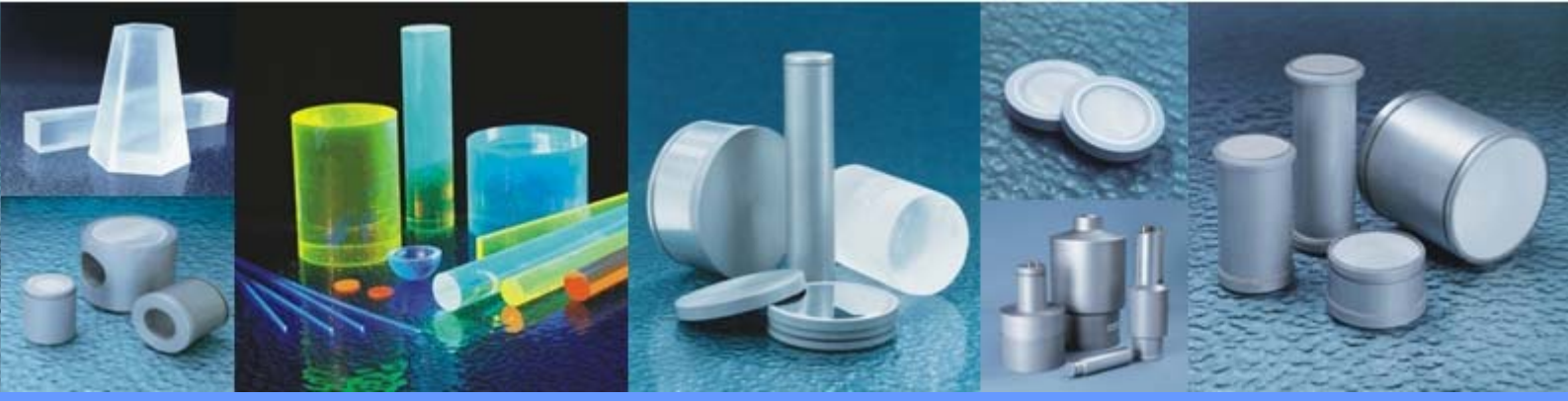

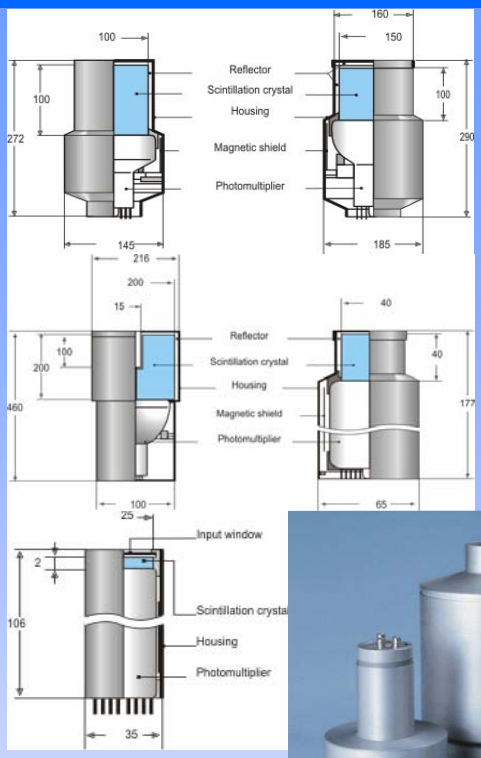

Detector Type D

Includes encapsulated scintillator with PMT, µ-metal shielding and socket

D-type
for standard applications

D/R-type
Ruggedized, for harsh environmental conditions

All of our products can be equipped with Am-241 sources for calibrating and avoiding gain shift due to temperature.

Complete Assembly Type A

Includes detector, voltage divider, connectors and other components upon request

A-type
for standard applications : detector, voltage divider, connectors

A/P-type
A-type equipped with Preamplifier (to be specified)

A/R-type
A-type Ruggedized for harsh environmental conditions

Presentation

Inorganic Scintillators 1

Inorganic Scintillators 2

Organic Scintillators 1

Organic Scintillators 2

Products

Accessories

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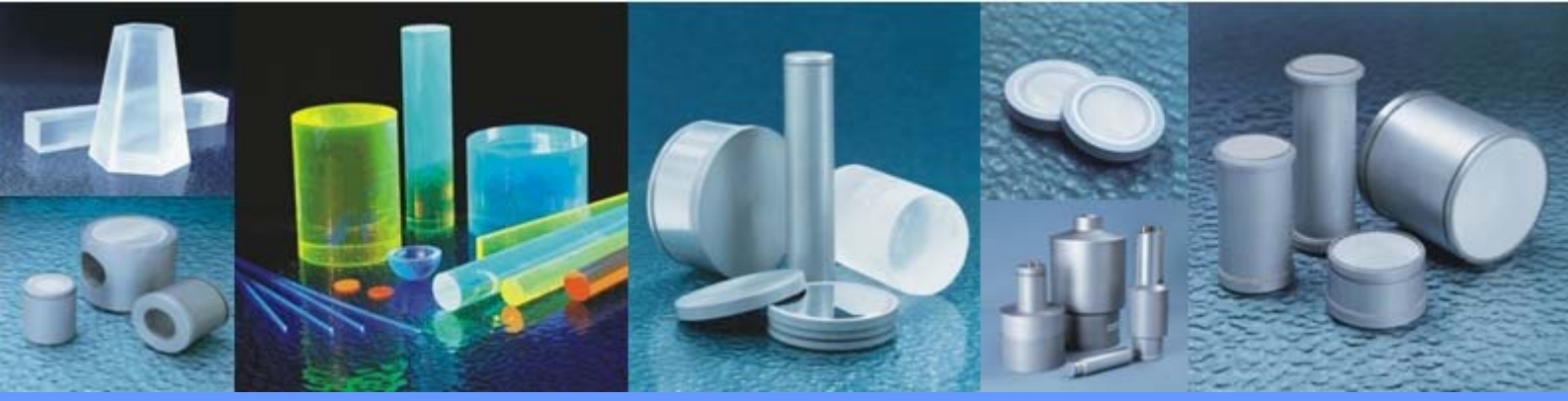


Wavelength shifter | electronic module

Presentation

Inorganic Scintillators 1

Inorganic Scintillators 2

Organic Scintillators 1

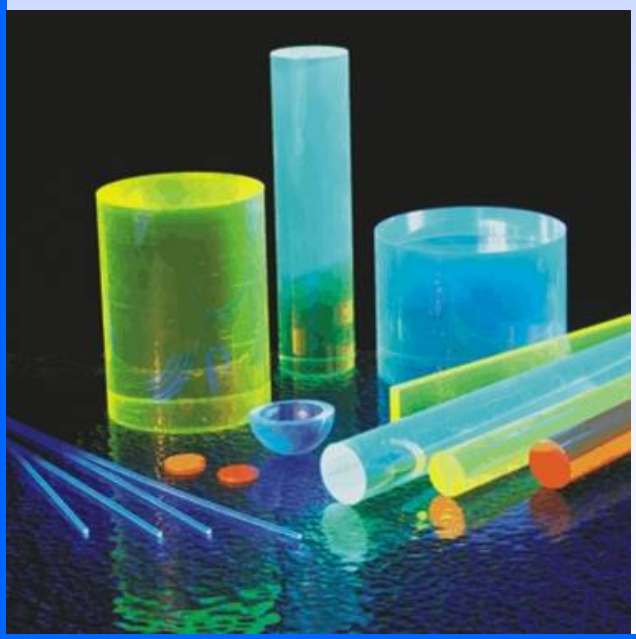
Organic Scintillators 2

Products

Accessories

Wavelength Shifters Rods

	Wavelength of max. emiss., nm	Light attenuation length, cm
PS-975	435	400
PS-976	445	400
PS-977	480	400
PS-978	590	400



Detec

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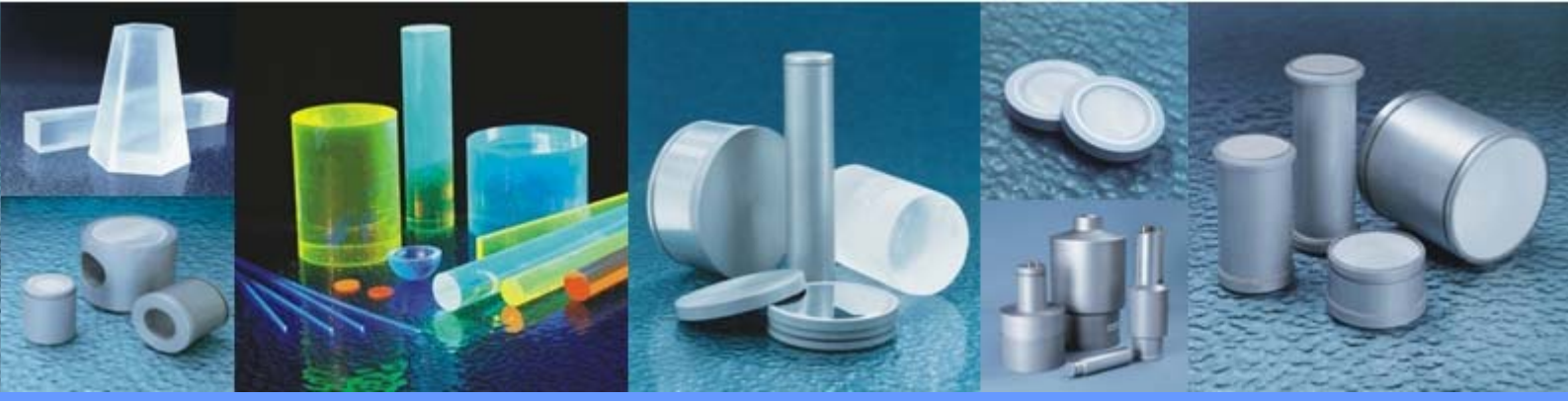

Waveklength shifter

electronic module

Charge preamplifier & High Voltage Power Supply

Charge preamplifier & HV Power Supply

Features

Voltage : ±12 V DC
Power : 200 mW
Compatible with Accuspec polystirol Plus

High Voltage Power Supply (PS)

600 to 1200 V DC generated from an external Low Voltage PS (2.5 - 5 V)
Max. Current : 400 mA
Low noise and low ripple
Negative polarity

Specifications

Accepts decoupled negative charge pulses from PMT based scintillation detector.
Max. Input - 3 V DC - AC coupled.

Input Power Requirements:

± 12 V for Preamplifier
+ 12 V for Power Supply

Input: Accepts negative polarity pulses from PMT - Sensitivity not less than 4 mV/pc.

Output: Provides positive pulses proportional to the charge delivered from a PMT.
Decay time: 0.5 µs, Rise time: 0.5 µs; Voltage up to 10 V, peak ; Zout > 50 Ω.
HV 600 to 1200 V DC, adjustable; 400 µA output current capability.

Controls: Adjustable from 600 to 1200 V by an external LVPS from 2.5 to 5 V

Performance

Ripple and Noise: 150 mV peak to peak at 1 µA.

Output Stability: Long-term drift of High Voltage: 0.05%/h and 0.08%/8h at steady-state bias voltage, load, and ambient temperature after a 30 minute warm-up.

Temperature: ± 50 ppm/°C after 30 minute warm-up. Operating range: 0 to 50 °C.

Max. Current: 500 mA maximum.

Connectors: HV Output : SHV, Preamplifier In & Out: BNC, Input Power: RS 232

Dimensions: 135mm×90mm×35mm

Preamplifier and HV Power Supply are also available in two different housings.

Presentation
Inorganic Scintillators 1
Inorganic Scintillators 2
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