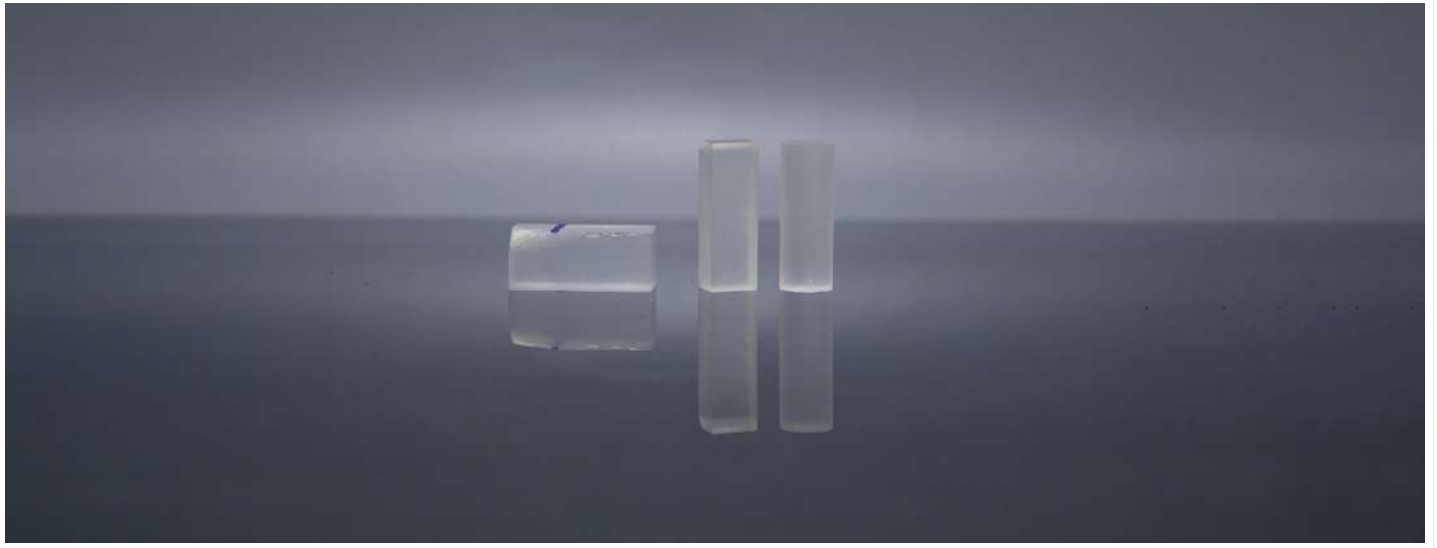


Y:BaF₂



DESCRIPTION

The Yb³⁺-doped crystals show very short decay time, but they have low LO due to thermal quenching. And 1 at% Y doping suppresses the slow scintillation component in BaF₂ crystals by a factor of 6, while the fast component remains unaffected.

Barium fluoride (BaF₂) crystal has a fast scintillation light peaked at 195 and 220 nm with a sub-ns decay time. This ultrafast scintillation promises a wide application in an area where extreme fast timing is important, such as future high-energy physics experiments, gigahertz hard X-ray imaging, and time-of-flight positron emission tomography. BaF₂ crystal, however, has also a slow scintillation component peaked at 310 nm with a decay time of about 600 ns, which causes pileup. The slow component in BaF₂ crystals can be suppressed by yttrium doping. BaF₂ provides a fast scintillation component with an ultrafast decay time of less than 0.6 ns and an ultrashort FWHM pulsewidth of less than nanoseconds, providing a solid foundation for an ultrafast scintillator. Its slow scintillation component with 600-ns decay time may be suppressed effectively by Y³⁺ doping. An imager consisting of bulk BaF₂:Y crystals may serve as a total absorption detector concept for gigahertz hard X-ray imaging for the proposed MaRIE project.

APPLICATIONS

- Fast inorganic scintillators
- Ultrafast front imager
- Subnanoseconds of decay time for the gigahertz hard X-ray imaging
- Compact sensor for gigahertz hard X-ray imaging

FEATURES

- Subnanoseconds of fast decay time
- Short attenuation length for 40-keV X-rays
- Provide high scintillation photon yield in the first nanoseconds
- Suppresses the slow scintillation component in BaF₂ crystals by a factor of 6, while the fast component remains unaffected.



Y:BaF₂

PARAMETERS

Material and Specifications

Orientation Tolerance	< 0.5°
Parallelism	20"
Perpendicularity	5'
Surface Quality	10-5 to MIL-O-13830A
Wavefront Distortion	<λ/4 @632.8 nm
Surface Flatness	<λ/8 @632.8 nm
Clear Aperture	>90%
Chamfer	<0.1×45°
Diameter Tolerance	±0.05 mm

Physical and Chemical Properties

Crystal Structure	Cubic
Symmetry Class	m3m
Lattice Constants	6.196
Specific Mass	4.89 g/cm ³
Melting Point	1280°C
Thermal Conductivity (W·m ⁻¹ ·K ⁻¹)@13°C	11.72
Specific Heat (J·kg ⁻¹ ·K ⁻¹)@27°C	410
Thermal Expansion (10 ⁻⁶ ·K ⁻¹ @-110...120°C)	18.1
Hardness (Mohs)	4
Elastic Coefficient (GPa)	C11=90.4, C12=40.6, C44=2503
Young's Modulus (GPa)	56.4
Shear Modulus (GPa)	25.4
Bulk Modulus (GPa)	268.89
Rupture Modulus (MPa)	26.2
Dielectric Constant	7.33@f=2MHz

Scintillator Characteristics

Emission Peak (nm)	220
Refractive Index @wavelength of the emission maximum	1.5
Normalized Light Yield	4.8
LO (p.e./MeV)	258
Total Light Yield (ph/MeV)	2000
Rise time (ns)	0.2
Decay Time (ns)	600
FWHM (ns)	1.4
Light Yield in 1st ns (photons/MeV)	1200
40keV Att.Length (1/e, mm)	0.106

Spectrum

