NaI

DESCRIPTION

NaI(Tl) or sodium iodide doped with thallium: NaI(Tl) is by far the most widely used scintillator material. It is available in single crystal form or the more rugged polycrystalline form (used in high vibration environments, e.g. wireline logging in the oil industry). Crystals with a higher level of doping are used in X-ray detectors with high spectrometric quality. Other applications include nuclear medicine, basic research, environmental monitoring, and aerial surveys.

Sodium iodide can be used both as single crystals and as polycrystals for this purpose. The iodine provides most of the stopping power in sodium iodide (since it has a high Z = 53). These crystalline scintillators are characterized by high density, high atomic number, and pulse decay times of approximately 1 microsecond (~ 10-6 sec). The wavelength of maximum emission is 415 nm.

NaI(Tl) is the most widely used scintillation material.

Sodium iodide activated with a trace amount of thallium converts about 15% of fast particle energy into light, a figure that is the highest among commonly used scintillation materials. The high atomic number of the iodine component ensures that large crystals of sodium iodide will fully absorb the energy of a large fraction of all incident gamma rays. NaI(Tl) detectors have other advantages, very large crystals can be grown and raw material is not expensive, which makes high efficiency for gamma ray detection is easily achieved. Sodium Iodide Thallium-doped crystals have a very high luminescence (scintillation) efficiency and are available in a wide variety of sizes and geometries. Because of all its advatnages, NaI(Tl) detectors became very soon one of the most convenient options for many applications, from radiology to environmental monitoring.

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APPLICATIONS

- Time-of-Flight measurements
- Positron lifetime studies
- Positron Emission Tomography (PET)
- Specialist applications in nuclear and high energy physics
- Used in high vibration environments
- Environmental monitoring
- aerial surveys

FEATURES

- Are one of the ‘brightest’ scintillators available
- Have good density and a high Z
- Have an optical output well match to the maximum sensitivity of commonly available PMTs
- Have good ‘rad hard’ properties
- Do not glow in the UV
- Have an optical output largely independent of temperature

PARAMETERS

Material and Specifications

Chemical formula	NaI
Molar mass	149.894
Appearance	white solid deliquescent
Crystal structure	Halite, cF8
Space group	Fm3m, No. 225
Lattice constant	a = 0.6462 nm
Formula units (Z)	4
Coordination geometry	Octahedral

Physical and Chemical Properties

Density (g/cm³)	3.67
Atomic Number (Effective)	56
Melting Point (ºK)	924
Boiling point (ºK)	1557
Thermal Expansion Coeff. (C^{-1})	47.4 x 10^{-6}
Cleavage Plane	<100>
Hardness (Mho)	2
Hygroscopic	Yes
Solubility (g/100gH_20)	TBA (23ºC)
Magnetic susceptibility (χ)	–57×10–6 cm3 mol–1
Heat capacity (C)	52.1 J mol–1 K–1

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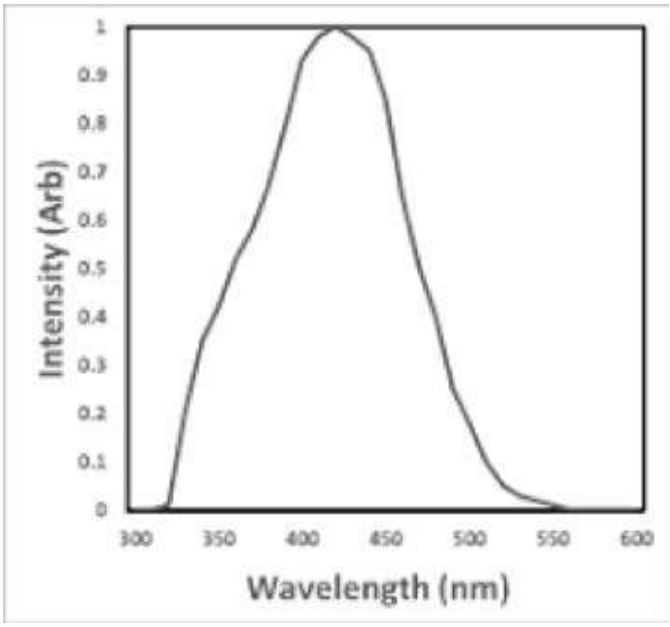
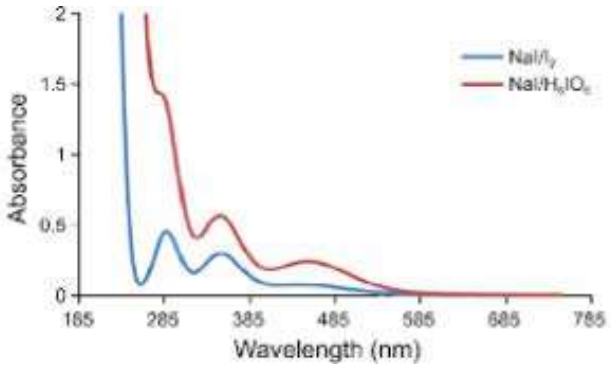
Optical and Spectral Properties

Wavelength (Max. Emission) (nm)	415
Wavelength Range (nm)	325 – 550
Decay Time (ns)	230
Light Yield (photons/keV)	55
Photoelectron Yield (% of NaI)	100
Radiation Length (cm)	2.6
Optical Transmission (μm)	0.15 – 12.5
Transmittance (%)	>90 (0.35 – 9μm)
Refractive Index	1.85 (@415nm)
Reflection Loss/Surface (%)	6.8



NaI Intensity vs. wavelength

Spectrum



NaI Absorption