**LBR/LaBr SCINTILLATION CRYSTAL BLANK SPECIFICATIONS**

LaBr, Lanthanum Bromide, when activated with small molar percentage of Cerium is an efficient High Z, Fast scintillator. The crystal is hygroscopic and to ensure machinability and better scintillation performance, certain anions and/or cat ions are added in various percentages to enhance the overall properties of this scintillation mixed-crystal phosphor. An optimum concentration of this proprietary addition is $\leq 5\%$. Hence, the acronym “LBR/LaBr”

**Physio-Chemical Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Name</td>
<td>Lanthanum Bromide</td>
</tr>
<tr>
<td>Chemical Formula</td>
<td>La(x)Br(x)</td>
</tr>
<tr>
<td>Density ($g/cm^3$)</td>
<td>5.06</td>
</tr>
<tr>
<td>Effective Atomic No. $Z_{eff}$</td>
<td>50</td>
</tr>
<tr>
<td>Type</td>
<td>Single Crystal</td>
</tr>
<tr>
<td>Structure</td>
<td>$P6_3/m$, No. 176</td>
</tr>
<tr>
<td>Optical Quality</td>
<td>Clear</td>
</tr>
<tr>
<td>Index of Refraction</td>
<td>1.82</td>
</tr>
<tr>
<td>Mechanical Behavior at Room Temp.</td>
<td>Brittle</td>
</tr>
<tr>
<td>Cleavage</td>
<td>None</td>
</tr>
<tr>
<td>Hardness (Mho)</td>
<td>5.8</td>
</tr>
<tr>
<td>Rugged</td>
<td>Yes</td>
</tr>
<tr>
<td>Hygroscopic</td>
<td>Yes</td>
</tr>
<tr>
<td>Melting Point ($^\circ$C)</td>
<td>783</td>
</tr>
</tbody>
</table>

**Radiation-Scintillation Properties**

- Relative light yield, PH (%)-PMT: $>1.7$ (compared to NaI(Tl))
- Photon Yield/Mev (PMT Sensor): 63,000
- $\Delta E/E$-% FWHM for Dia. = Ø60” x 10mm L: **2.7% BEST MEASURED**
- Emission Peak Wavelength (nm): 380
- Decay Constant At Room Temp. (ns): 16-26 Depending on Ce Content
- Afterglow at 3 msec (%):
- Rise Times-ns (10%-90%)
- Radiation Length (cm): 2.13
- Radiation Hardness To $\gamma$ Ray (rad): $>10^5$

**Background**

[A peculiarity of the lanthanum-based scintillators is the presence of an inherent background originating from the electron capture and $\beta$-decay of the long-lived minor La isotope $^{138}$La ($t^{1/2} = 1.05 \times 10^{11}y$) to $^{138}$Ba (66.4%) and $^{138}$Ce (33.6%, see schematic decay scheme in Fig. 1). The Ba X-ray peak visible in the LaBr$_3$ spectra in Figs. 2 and 3 results from the EC decay of $^{138}$La to $^{138}$Ba (the single X-ray peak near 37.4 kev in fact represents the accumulated energy given off by the X-rays in the EC process). The $\beta$-decay to $^{138}$Ce, in turn, manifests itself in a beta continuum background with an end-point energy of 255 kev.
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Uranium Enrichment Assay with a LaBr₃(Ce) Scintillation Detector: A Promising Option for the 2nd Generation of COMPUCEA

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LBR/LaBr₃ CRYSTAL BLANK SPECIFICATIONS

Dimensions: Length________ Width________ Height________

OR

Diameter_______ Length________

OR

For Other Geometries Attach a Drawing or Sketch

Tolerances: All dimensions +.25/-00mm (+.010"/-.000")

Resolution: For Dia. = Ø10mm x 10mm Length ≤3% FWHM @ 662Kev for Cs137*

Appearance: Crystal blanks are to be water white with NO visual imperfections. Such imperfections typically include flock & inclusions, striae, edge cracks due to heat fractures, etc. - The crystal blank should be free from these defects.

*As measured with a catalog spec. Hamamatsu R-1306 2" PMT or equivalent

It is not necessary to measure each and every blank. A representative sample cut from the same boule or ingot-section should meet this performance criteria.

All surfaces supplied are at minimum industry-standard scintillation polish, unless otherwise specified.