3M Science. Applied to Life.™

3M Advanced Materials Division

3M™ Ultra High Purity Boron

Introduction

3M Technical Ceramics, Inc. manufactures UHP boron products enriched in ^{11}boron. These products are produced using a unique proprietary process that yields a high purity metallic product. The following general characteristics are applicable to UHP boron products. Some of these data are based on naturally-occurring boron and may not reflect other specific isotope concentrations.

Typical Physical Properties

(Not for specification purposes)

Composition	3M™ Ultra High Purity Boron
Enrichment	> 98% ^{11}B
Molecular Weight	10.99 for 98% ^{11}B
Crystalline Structure	Beta Rhombohedral
Density	2.38 g/cm^3 for 99% ^{11}B
Thermal (n,∝) Cross Section (Barns)	0.005 for ^{11}B
Atomic Mass Number	11.00931 for ^{11}B

Thermal and Electrical Properties

(Not for specification purposes)

Property	3M™ Ultra High Purity Boron
Melting Point	2250 ±50°C
Boiling Point	2550°C
Resistivity @ 25°C	1.8 to 2 × 10^6 ohm-cm
Specific Heat	0.25 cal/gram/°C @ 20°C
Thermal Conductivity	0.065 cal/cm sec°C @ 25°C

Mechanical Properties

(Not for specification purposes)

Property	3M™ Ultra High Purity Boron
Hardness (Mohs' scale)	9.3
Hardness (Knoop-100 gram load)	3300 kg/mm^2
Shear Modulus	24,000 kg/mm^2
Youngs Modulus	47,000 kg/mm^2
Surface Tension	1100 dynes/cm

3M™ Ultra High Purity Boron - Listed Impurities

Element	3M 5Ns UHP Boron* Specification (ppm, max.)	3M 6Ns UHP Boron** Specification (ppm, max.)	Element	3M 5Ns UHP Boron* Specification (ppm, max.)	3M 6Ns UHP Boron** Specification (ppm, max.)
Ag	–	0.01	Mg	2	0.5
Al	0.4	0.2	Mn	–	0.025
As	1	0.01	Mo		0.05
Ba	–	0.1	Na	0.5	0.5
Bi	–	0.04	Ni	–	0.05
Ca	–	0.5	P	3	0.5
Cd	–	0.1	Pb	0.1	0.03
Co	–	0.02	Sb	0.1	0.01
Cr	0.2	0.1	Se	–	0.01
Cu	0.3	0.1	Si	10	1
Fe	2	0.5	Sn	–	0.03
Ga	–	0.07	Sr	–	0.1
Ge	–	0.02	Ti		0.05
Hg	0.3	0.01	V	–	0.05
K	2	0.1	Zn	–	0.5
Li	–	0.1			

*Total of listed impurities <10.0 ppm
**Total of listed impurities <1.0 ppm

Product Purity

3M UHP boron is offered under the tradenames 3M™ 5Ns and 6Ns Ultra High Purity Boron. These products were developed with the special needs of the silicon wafer industry in mind – specifically, the increasing demands for higher purity. Today, with the industry enduring exceptional pressures to provide both performance and economy, 3M Technical Ceramics is focused on delivering value as well. The methods used to verify the purity of these products reflect the leading edge of technology.

Particle Sizes

- Chunk
- -8 +20 mesh
- -25 +40 mesh

Packaging

3M 5Ns and 6Ns ultra high purity boron are packaged in glass or poly bottles containing from 5 to 50 grams of product. Each bottle is purged with inert gas prior to sealing. Bottles are packaged in appropriate cushioning and a fiberboard carton. A Certificate of Analysis is provided for each lot shipped.

Boron Enrichment Capabilities

3M Technical Ceramics is a leading global commercial processor of enriched boron, and is one of the largest boron isotope enrichment facilities in the world today. We focus on manufacturing optimized materials with an emphasis on stable boron isotopes. Our proprietary manufacturing processes allow ^{10}B and ^{11}B enrichment from natural occurring ratios up to levels exceeding 99% isotopic purity. We offer secure supply, consistent product quality and the ability to custom engineer products for your unique applications. Our specialists are experts at solving materials-related problems in the demanding nuclear and semiconductor industries. For more information, contact us at **boron@mmm.com**.

Analytical Services

As a manufacturer of specialty, high purity chemical and isotopic products, 3M Technical Ceramics maintains sophisticated analytical and testing capabilities at our manufacturing facility in Quapaw, OK. Our analytical laboratories support on-site production activities and assure our customers that the products they receive meet or exceed their requirements. Our laboratories are fully equipped with current-generation instruments to perform a full range of testing procedures, including: inductively coupled plasma mass spectrometry; atomic absorption spectroscopy; ion and gas chromatography; carbon/sulfur and oxygen/nitrogen analysis; particle size analysis and BET surface area measurement.

Product Storage, Handling and Safety

Storage: Store away from heat. Store away from oxidizing agents. See product Safety Data Sheet (SDS) for additional information.

Handling: Avoid breathing dust/fume/gas/mist/vapors/spray. Do not eat, drink or smoke when using this product. Wash thoroughly after handling. Avoid contact with oxidizing agents (eg. chlorine, chromic acid etc.). Dust clouds of this material in sufficient concentration in combination with an ignition source may be explosive. Dust deposits should not be allowed to accumulate on surfaces because of the potential for secondary explosions. Routine housekeeping should be instituted to ensure that combustible dusts do not accumulate on surfaces. Solids can generate static electricity charges when transferred and in mixing operations sufficient to be an ignition source. Evaluate the need for precautions, such as grounding and bonding, low energy transfer of material (e.g. low speed, short distance), or inert atmospheres. See product Safety Data Sheet (SDS) for additional information.

Safety: Handling of this material may be hazardous. May form combustible dust concentrations in air. See product Safety Data Sheet (SDS) for additional information.

Regulatory Summary

One or more components in this material are approved for specific commercial use under a U.S. EPA Low Volume Exemption.

Approved commercial use:

1. Resistivity dopant for silicon metals.

Refer to SDS for additional information.

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