

## Ceramics Thermal Management Solutions

### Thermal Management

In high performance electronics, packaging is the limiting factor in electrical circuit efficiency. Specifically, thermal management, along with reliability and the trend toward miniaturization are key factors in successful electronic design.

Thermal management becomes a critical design consideration when:

- The physical size of the device or the enclosure is reduced.
- The device is exposed to high ambient temperatures.
- Airflow or liquid cooling is not practical or prohibitively expensive.
- Greater reliability is required by the application.

Materion Ceramics offers solutions to these demanding requirements in the form of beryllium oxide (BeO) ceramics.

Beryllia ceramic packaging is a technology that enables electronics to achieve higher speeds, smaller size, and higher reliability.



### Beryllia Ceramics Provide:

Thermal conductivity second only to diamond among electrically insulating materials, dissipating over 325 W/mK at room temperature.

- A coefficient of thermal expansion (CTE) intermediate to silicon or gallium arsenide and metals.
- Electrical resistivity and dielectric strength equivalent to competitive materials.
- Low dielectric constant (6.7) and low loss index (.0012 at 1 MHz), permitting improved circuit performance at high frequencies.
- An inherent stability in oxidizing and reducing high dew point atmospheres, unlike nitrides, which will decompose to their oxide equivalent.

### Capabilities

Beryllia parts are produced by four basic methods. Simple and complex shapes in a wide range of sizes can be dry pressed or isopressed. Additionally, electrical substrates can be cast in thin sheets from a slurry of beryllia. Symmetrical cross sections such as rods and tubes are extruded through steel dies.

These materials are then fired and additional processing such as grinding, lapping or tumbling is performed to meet particular requirements. Our plant has extensive capabilities for beryllia powder production, ceramic fabrication and high tolerance machining, using state-of-the-art equipment and the latest statistical process control methods. We also maintain a specialty metallization and assembly capability, largely for exacting beryllia-to-metal seal applications.

Brush Ceramic Products has pioneered and developed beryllia ceramics technology for over 60 years. Future ceramic and packaging developments will be based on partnering Brush's capabilities with the specifying engineer's demanding performance criteria. Our engineering staff will assist you in maximizing the electrical, thermal, and mechanical properties of your application by providing innovative alternatives and design concepts. We are positioned to respond to your challenge.

**Mining and Extraction** – Brush Resources mines bertrandite ore in Central Utah and converts it into beryllium hydroxide ore concentrate. Beryllium hydroxide is processed in Elmore, Ohio, where it is converted into beryllium, beryllium alloys and beryllium oxide.

**Beryllium** – Beryllium is one of the lightest structural materials known, with a density one-third that of aluminum, yet has specific stiffness six times greater than steel. Hence, beryllium is the material of choice for a wide variety of critical components in aerospace systems, data processing, medical and computer applications.

**Ceramics** – Beryllia ceramics are in high demand in the electronics industry because they offer superior performance at high temperatures. Beryllia ceramics can be found in products such as:

- Medical lasers for DNA analysis, skin resurfacing, cataract removal, non-invasive surgery, RK surgery, kidney stone removal, detection of blindness and HIV testing.
- Automobile ignition systems (to increase gas mileage) and various sensors.
- Transmitters for radio frequency (RF) applications such as cellular phones and base stations, high definition television (HDTV) and cable television.
- Military defense systems (missile guidance).

#### Health and Safety

Handling beryllium oxide ceramics in solid form poses no special health risk. Like many industrial materials, beryllium-containing materials may pose a health risk if recommended safe handling practices are not followed. Inhalation of airborne beryllium may cause a serious lung disorder in susceptible individuals. The Occupational Safety and Health Administration (OSHA) has set mandatory limits on occupational respiratory exposures. Read and follow the guidance in the Material Safety Data Sheet (MSDS) before working with this material. For additional information on safe handling practices or technical data on beryllium oxide ceramics, contact Materion Ceramics at 520-746-0251.



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