FREUDIGER

HEM SAPPHIRE (Heat Exchange Method)

The Heat Exchange Method (HEM) is a technique used to grow large, high-quality synthetic Sapphire crystals. This method is particularly known for its exceptional optical clarity, structural integrity, and thermal stability. It is widely used in industrial applications where these properties are crucial.

Growth Process

- In Heat Exchange Method (HEM) the Sapphire crystal grows in a specially designed furnace where heat is carefully controlled and distributed. The process is designed maintain a precise temperature gradient.
- Controlled Growth: The slow cooling and precise temperature control result in a crystal with fewer defects and inclusions, leading to high optical clarity and uniformity.

Chemical Composition

- Formula: Al_2O_3 (Aluminum oxide)
- EFG Sapphire is chemically identical to natural Sapphire, consisting of pure aluminum oxide with minimal impurities.

Physical Properties

- Hardness: 9 on the Mohs scale, only second to diamond
- Density: Approximately 3.98

Optical Properties

- Clarity: HEM Sapphires have exceptional clarity due to the controlled growth process, which minimizes inclusions and defects.
- Transparency: High transparency, making these Sapphires ideal for high end optical applications.
- Birefringence: Low birefringence, which is desirable for applications requiring consistent optical properties.
- Transmission range: 0.15 to 5.5 micron (from UV to mid-IR)

Mechanical Properties

- High mechanical strength, making HEM Sapphire suitable for demanding applications where durability is critical.
- Excellent wear resistance due to its hardness.
- Thermal Conductivity: High thermal conductivity, which is useful in heat-dissipating components.

Thermal Properties

- Melting Point is approximately 2,050°C, similar to other forms of Sapphire.
- Excellent resistance to thermal shock, allowing it to withstand rapid temperature changes without cracking.
- Thermal Conductivity: 25 W/mK at 300K

Applications

- Optical Components: HEM Sapphire is commonly used in the production of high-quality optical windows, lenses, and other components that require superior clarity and durability.
- Semiconductors: It is widely used as a substrate in LED manufacturing and other semiconductor applications due to its excellent thermal and electrical properties.
- Aerospace: Employed in aerospace applications for windows and other components that require extreme durability and resistance to harsh environments.
- Watch Crystals: Used for high-end watch faces due to its scratch resistance and clarity.
- Medical Devices: Applied in medical lasers and other devices where high-purity, transparent materials are required.

Market Value

Industrial Applications: HEM Sapphires are valued primarily for their use in high-tech and industrial applications, where their superior properties are critical. The cost is often related to the size, purity, and intended application of the Sapphire.