HEM Sapphire

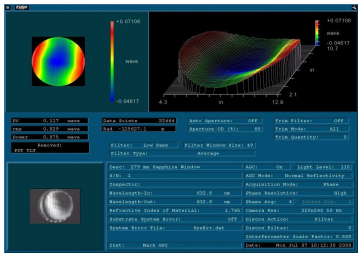
Product: HEM Sapphire for Optical Applications

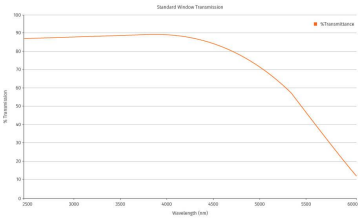
New for aerospace and defense applications: Large-format, high-quality HEM-grown sapphire boules.

HEM® sapphire windows are the most widely used synthetic sapphire in optical applications. Our superior optical quality sapphire is available in large A-plane sapphire window sizes up to 22” diameter with unrestricted thickness.
HEM® sapphire M-, C-, and r-plane windows are available up to 9” in diameter, also with unrestricted thickness.

HEM® optical sapphire material exhibits the unique capability of having a broad transmission range from 150 nm to 5.5 microns; other synthetic materials have absorption bands. HEM® sapphire transmission and homogeneity are the highest in the industry and this material is the most widely used for sapphire reconnaissance windows, sapphire domes, and sapphire lenses.

Sapphire window performance is only as good as the bulk sapphire material it is made from. HEM® sapphire properties are proven to combine high optical transmission, low transmitted wavefront distortion, and outstanding mechanical-strength properties at high and low temperatures. Data shows that the homogeneity for all grades of HEM® sapphire is in the 0.1 ppm range, with the highest grades better than 0.05 ppm. HEM® sapphire windows are currently performing in uncompromising environments in aerospace, High Power Lasers (HEL), and astronomy applications.

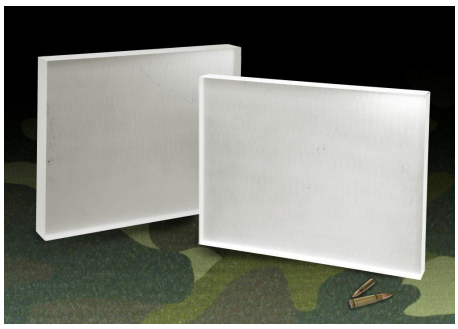


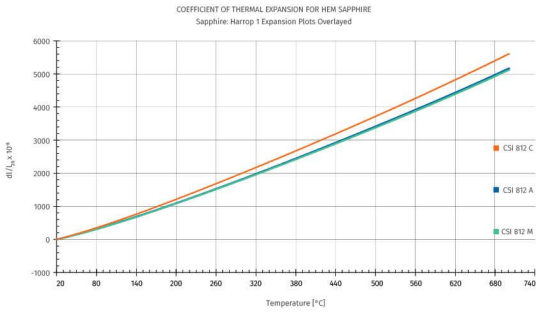


HEM® sapphire is the #1 leading sapphire material for highly sophisticated optical applications that require reliability, strength and a wide range of light transmittance. HEM Sapphire transmits light over a broad wavelength range spanning from 150nm to 5.5 microns.

- <80 ppm absorption @1064nm
- Low dn/dt over a wide range of lengths, (window temperature gradient does not cause image blur or foresight error)
- High mechanical strength for high-pressure and shock-loading applications
- Refractory temperature tolerance to within a few hundred degrees to its 2040°C melting point
- Chemical resistivity stable in many acid environments at high temperatures
- An attractive choice for laser host applications and use at cryogenic temperatures because of high thermal conductivity
- Thermal shock resistance because high strength and high thermal conductivity allow it to survive extreme thermal shock conditions
- High resistance to solarization radiation effects
- Hardness – excellent rain erosion resistance and low frictional coefficient
- High dielectric constant (9.39 from 1.0 MHz to 8.5 GHz)

Applications:Large HEM® sapphire windows are currently operating on the most advanced aerospace platforms. These 22" diameter sapphire aerospace windows are flight and performance-proven with wavefront values of 1/10 wave, high optical transmittance, strength, and durability. Large-sized HEM® sapphire windows are replacing ALON windows because of superior performance, lower cost, and immediate availability. Flight safety testing has proven that HEM® sapphire windows are fit for pressurized applications where the HEM® sapphire window is the only barrier between the flight crew and the outside environment. In fact, Crystal Systems' sapphire has achieved a Technology Readiness Level of 9 (TRL-9), which means the material has been thoroughly proven in the most demanding aerospace applications, from deep-sea to space.Large C-plane HEM® sapphire windows are distinguished for being the largest and highest quality non-birefringent sapphire optics available in the industry. This non-birefringent material excels for use in laser windows, High Energy Lasers (HEL), and laser mirrors because of hardness (9 on the Mohs scale), thermal shock resistance and high laser damage threshold (LDT). Sapphire is also increasingly viewed as a window material upgrade from Zinc Sulfide (ZnS) and Magnesium Fluoride (MgF2) for airborne applications. It is well known that HEM Sapphire is commercially available unlike other "promising" specialty optical materials such as ALON and Spinel which are more expensive and unable to deliver on promised performance.Thanks to a robust dedication to material R&D, Crystal Systems is committed to supporting customers with new sapphire solutions to address their unique needs.





HEM® Sapphire for Mechanical Applications

HEM® sapphire is used in many mechanical applications because of its large size, strength, abrasion resistance and chemical stability. HEM® sapphire has undergone extensive compressive and tensile strength testing at many different temperatures in order to understand its intrinsic failure modes and suitability for different applications. HEM® sapphire material is used in high operating temperatures above 1,200 degrees Celsius because of its thermal shock resistance. However, it is critical to leverage sapphire's intrinsic strength by using proper optical fabrication equipment and processing know-how. Low damage operations result in high-strength sapphire parts. Moreover, sapphire's anisotropic nature requires that crystallographic orientations be optimized for the direction of forces and temperatures to which the component will be subjected. We have done the mechanical testing and analysis and will guide our customers with this knowledge.

Sapphire-glass replacement is increasingly taking place as sapphire easily outperforms glass in mechanical applications. Even the most engineered glass types cannot compete with HEM® sapphire. Crystal Systems' experience spanning nearly five decades is focused not only on growing crystal but also on engineering furnace designs and adopting new processing techniques to meet ever-stringent customer demands.

Attributes

- Melting point of 2040 C
- Hardness of 9 on the Mohs scale
- High conductivity at cryogenic temperatures
- Inert to chemicals at high temperatures
- Low coefficient of thermal expansion
- High compressive strength
- High flexural strength at elevated temperatures

Applications: Mechanical HEM® sapphire applications include; sapphire wafer carriers, sapphire dental brackets, sapphire fire windows, sapphire view ports, sapphire nozzles, sapphire bearings, sapphire blades, sapphire tubes, sapphire jewel bearings and sapphire transparent armor to name just a few. HEM® sapphire will safely operate where other structural materials will fail. The current and emerging engineering applications for mechanical Sapphire rely on consistent mechanical strength, purity and orientation homogeneity. Crystal Systems' unique HEM® growth processes and extensive fabrication capabilities are fueling the replacement of less optimized crystal and glass materials with HEM® sapphire.