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Transparent Alumina by Hotpressing Platelets into an Aligned Grain Microstructure

A cost-effective technique uses hot-pressing of platelet alumina crystals to create highly transparent, high-density polycrystalline alumina for use in armored windows, rocket nose cones, and protective shields across a broad spectral range.

Researchers at Purdue University have developed new highly transparent polycrystalline alumina materials by

hot-pressing platelets alumina crystals and aligning its grain structure to induce low amounts of grain boundary refraction and reflection. This cost-effective transparent alumina processing technique can be used for applications including high-temperature and armored windows, nose cones for rockets, and ballistic blast as well as protective shields. Purdue researchers have fine-tuned fabrication parameters for the new alumina including specified powder and treatment steps sintering temperatures, green-body and hot-pressing geometries, pre-load pressures and hot pressing pressure to achieve a high density of upwards of 99.95%. This allows a real in-line transmission (RIT), defined as a transmission within a 0.5 degree cone of the center beam, of over 70% and a total transmission of over 80 % at 645nm, approaching the theoretical limit of single crystal sapphire (86%). Notably, the aligned grain microstructure limits grain-induced scattering typically seen with polycrystalline translucent alumina with variance of only 15% in RIT over the wavelength range 280 nm to 2500 nm, allowing this material to be continuously effective in a spectral range from UVB to NIR.

Advantages:

-Transparent

-Cost-Effective

Potential Applications:

Technology ID

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Category

Materials Science & Nanotechnology/Advanced Functional Materials
Aerospace & Defense/Advanced Protective Materials & Wearable PPE
Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

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View online

-Nose Cones for Rockets

-High-Temperature and Armored Windows

-Blast and Protective Shields

Recent Publication:

"Hot-pressing platelet alumina to transparency"

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