



# NAVAL RESEARCH LABORATORY

## The Corporate Laboratory for the Navy and Marine Corps

### Transparent Spinel Ceramic

The Naval Research Laboratory (NRL) has developed a suite of processes to create transparent spinel ( $MgAl_2O_4$ ) ceramic, which is superior to the glass, sapphire, and other materials traditionally used for applications such as high-energy laser windows and lightweight armor. Commonly-used vacuum hot presses are utilized to sinter spinel powder into transparent solid materials. The NRL method includes a novel spray-coating process to uniformly coat the spinel powder particles with a sintering aid. As a result, the amount of sintering aid required was reduced significantly, while still allowing the end product to be sintered to full density and transparency. Additionally, the sintering process was modified to completely eliminate residual LiF through evaporation and thereby avoids unwanted chemical reactions.



#### Advantages

- Excellent transmission in visible wavelengths and mid-wavelength infrared (0.2 – 5.0  $\mu m$ ) – superior to sapphire.
- Process scalability to large sizes and complex shapes.
- Strong, rigid, and environmentally durable.
- Reduced manufacturing cost over existing technologies – high reproducibility, high yield.

#### Application Areas

- Consumer electronics (e.g. cell phones, watches, cameras)
- High energy lasers
- Transparent armor

#### Reference

- “Analysis of Scattering Sites in Transparent Magnesium Aluminate Spinel,” *Ceram. Eng. Sci. Proc.*, **26** (2005) 293–298.
- “Degradation of Magnesium Aluminum Spinel by LiF Sintering Aid,” *J. Am. Ceram. Soc.*, **88** (2005) 1321–1322.

#### Licensing and Collaboration Opportunities

US Patent No. 7,211,325; 7,528,086; 7,563,480; 7,611,661; 7,670,685; 7,875,311; 7,927,705; 8,221,887; 8,266,924; and US Patent Publication No. US20130160492 are available for license to companies with commercial interest. Collaborative research and development is available under a Cooperative Research and Development Agreement (CRADA).

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