

# Transparent Spinel Armor Manufacturing Scale-Up

## PROBLEM / OBJECTIVE

Transparent spinel ceramic is a material that provides a unique combination of improved protection, significant abrasion resistance and excellent optical properties. This makes it an ideal transparent material for defense, aerospace, and commercial applications. For DoD applications, spinel can yield thickness and weight reductions of 50% compared to glass based armor solutions, while maintaining ballistic performance and outstanding electromagnetic and optical transparency. However, fabrication capability for transparent ceramic spinel was not adequate for tactical vehicle requirements. The objective of this effort was to scale up manufacturing capabilities.

## ACCOMPLISHMENTS / PAYOFF

### Process Improvement:

Army ManTech demonstrated processes to enable spinel plates as large as 30" x 50" and produce approximately 24,000 square feet of transparent spinel per year. Specific accomplishments of this effort included:

- Improved powder batching procedures and multiple plate pressing
- Increased window size for DoD applications from 170 in<sup>2</sup> to 700 in<sup>2</sup>
- Demonstrated manufacture of curved spinel plates up to 25" x 32"

### Implementation and Technology Transfer:

Spinel has been used on Army vehicle demonstrators. Leveraging with the Defense-Wide Manufacturing Science and Technology (DMS&T) program Industrial Base Innovation Fund further transitioned:

- Ballistic quality spinel plates to meet Army tactical vehicle needs and other transparent applications such as armor gun shields and specialty vehicles
- UH-60 and CH-47 curved armor for qualification
- Advanced Targeting Forward-Looking Infrared (AT-FLIR) and Sniper Advanced Targeting Pods (ATP) for reconnaissance aircraft

The Navy has leveraged Army ManTech investments by developing hot-pressed spinel for implementation on the IR window for its new DDG-1000 destroyer program.



### Expected Benefits and Warfighter Impact:

This effort demonstrated weight savings and thickness reductions of 50-60% over current systems. Operations and Support (O&S) cost savings as a result of reduced vehicle maintenance and increased window service life.

This program reduced manufacturing costs of spinel plates for transparent armor by 50% and enabled numerous Defense applications of this material.

## TIME LINE / MILESTONE

Start Date	October 2007
End Date (Transparent Spinel Phase)	April 2012

## FUNDING

U.S. Army ManTech	\$9.0M
DMS&T (2012 and 2013 IBIF)	\$3.2M

## PARTICIPANTS

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