Transparent Spinel Armor Manufacturing Scale-Up

**PROBLEM / OBJECTIVE**

Transparent spinel armor windows provide lighter weight and improved ballistic protection for tactical vehicles. They have demonstrated multi-hit performance at weights and thicknesses less than currently deployed glass-based transparent armor. Fabrication capability for transparent ceramic spinel is not optimized for tactical vehicle requirements, which need up to 600 square inch panels.

**ACCOMPLISHMENTS / PAYOFF**

**Process Improvement:**

Army ManTech demonstrated processes will be able to make spine plates as large as 30” x 50” and produce approximately 24,000 square feet of transparent spinel per year. Specific accomplishments to date include:
- Improved powder batching procedures and multiple plate pressing
- Improved grinding methodology
- Rapid polishing
- Use of larger processing equipment to increase economies of scale and improve yield
- Increasing number of plates per hot pressing cycle
- Implementing improved inspection/reject procedures

**Implementation and Technology Transfer:**

Light weight transparent armor has been installed on the FMTV (Family of Medium Tactical Vehicles) Tactical Wheeled Vehicle Survivability (TWVS) technology demonstrator.

The size of hot-pressed spinel plates available for DoD applications has been increased from 170 to over 400 square inches. Advances in spinel powders and spinel powder processing developed under this program for hot-pressing have also advanced the sintering technology to make electromagnetic domes.

The Navy is flight testing hot-pressed spinel in the window of the new AN/ASQ-228 Advanced Targeting Forward Looking Infrared targeting pod (AT-FLIR) being developed for the Navy F-18 Hornet. The Navy is also developing hot-pressed spinel for IR window on new DDG-1000 destroyer program.

Spinel based transparent armor has been supplied to US Special Operations Command for evaluation.

**Expected Benefits and Warfighter Impact:**

The program directly benefits the Warfighter. This material has superior resistance to scratching, sand erosion, and fracture due to rock strikes and also provides better visibility. Weight savings and thickness reductions of 50-60% over current systems provide lighter vehicle weight. Operations and Support (O&S) cost savings will be achieved as a result of reduced vehicle maintenance and increased window service life.

This program reduced manufacturing costs of spinel plates for transparent armor armor by 20-50%.

Return on Investment is projected at 8.7 to 1 with a cost benefit of $68M.

**TIME LINE / MILESTONE**

<table>
<thead>
<tr>
<th>Start Date</th>
<th>End Date (Transparent Spinel Phase)</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 2007</td>
<td>April 2012</td>
</tr>
</tbody>
</table>

**FUNDING**

U.S. Army ManTech $9.0M

**PARTICIPANTS**

U.S. Army Research Development and Engineering Command (RDECOM) Army Research Laboratory Technology Assessment and Transfer, Annapolis, MD

ArmorLine Corporation, Indian Land, SC