Air Force testing new transparent armor

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WRIGHT-PATTERSON AIR FORCE BASE, Ohio (AFPN) -- Engineers here are testing a new kind of transparent armor -- stronger and lighter than traditional materials -- that could stop armor-piercing weapons from penetrating vehicle windows.

The Air Force Research Laboratory's materials and manufacturing directorate is testing aluminum oxynitride -- ALONtm -- as a replacement for the traditional multi-layered glass transparencies now used in existing ground and air armored vehicles.

The test are being done in conjunction with the Army Research Laboratory at Aberdeen Proving Grounds, Md., and University of Dayton Research Institute, Ohio.

ALONtm is a ceramic compound with a high compressive strength and durability. When polished, it is the premier transparent armor for use in armored vehicles, said. 1st Lt. Joseph La Monica, transparent armor sub-direction lead

"The substance itself is light years ahead of glass," he said, adding that it offers "higher performance and lighter weight."

Traditional transparent armor is thick layers of bonded glass. The new armor combines the transparent ALONtm piece as a strike plate, a middle section of glass and a polymer backing. Each layer is visibly thinner than the traditional layers.

ALONtm is virtually scratch resistant, offers substantial impact resistance, and provides better durability and protection against armor piercing threats, at roughly half the weight and half the thickness of traditional glass transparent armor, said the lieutenant.

In a June 2004demonstration, an ALONtm test pieces held up to both a .30 caliber Russian M-44 sniper rifle and a .50 caliber Browning Sniper Rifle with armor piercing bullets. While the bullets pierced the glass samples, the armor withstood the impact with no penetration.

In extensive testing, ALONtm has performed well against multiple hits of .30 caliber armor piercing rounds -- typical of anti-aircraft fire, Lieutenant La Monica said. Ttests focusing on multiple hits from .50 caliber rounds and improvised explosive devices are in the works.

The lieutenant is optimistic about the results because the physical properties and design of the material are intended to stop higher level threats.

"The higher the threat, the more savings you're going to get," he said. "With glass, to get the protection against higher threats, you have to keep building layers upon layers. But with ALONtm, the material only needs to be increased a few millimeters."

This ability to add the needed protection with only a small amount of material is very advantageous, said Ron Hoffman, an investigator at University of Dayton Research Institute.

"When looking at higher level threats, you want the protection, not the weight," Mr. Hoffman said. "Achieving protection at lighter weights will allow the armor to be more easily integrated

into vehicles."

Mr. Hoffman also pointed out the benefit of durability with ALONtm.

"Eventually, with a conventional glass surface, degradation takes place and results in a loss of transparency," Mr. Hoffman said. "Things such as sand have little or no impact on ALONtm, and it probably has a life expectancy many times that of glass."

The scratch-resistant quality will greatly increase the transparency of the armor, giving military members more visual awareness on the battlefield.

"It all comes down to survivability and being able to see what's out there and to make decisions while having the added protection," Mr. Hoffman said.

The Army is looking to use the new armor as windows in ground vehicles, like the Humvee, Lieutenant La Monica said. The Air Force is exploring its use for "in-flight protective transparencies for low, slow-flying aircraft. These include the C-130 Hercules, C-17 Globemaster III, A-10 Thunderbolt II and helicopters.

While some see the possibilities of this material as limitless, manufacturability, size and cost are issues the lab is dealing with before the armor can transition to the field, the lieutenant said.

"Traditional transparent armor costs a little over $3 per square inch. The ALONtm Transparent Armor cost is $10 to $15 per square inch," Lieutenant La Monica said. "The difficulties arise with heating and polishing processes, which lead to higher costs. But we are looking at more cost effective alternatives."

Lieutenant La Monica said experimenting with the polishing process has proven beneficial.

"We found that by polishing it a certain way, we increased the strength of the material by two-fold," he said.

Currently, size is also limited because equipment needed to heat larger pieces is expensive. To help lower costs, the lieutenant said researchers are looking at design variations that use smaller pieces of the armor tiled together to form larger windows.

Lowering cost by using a commercial grade material is also an option, and the results have been promising.

"So far, the difference between the lower-grade material and higher purity in ballistic tests is minimal," he said.

Lieutenant La Monica said once the material can be manufactured in large quantities to meet the military's needs, and the cost brought down, the durability and strength of ALONtm will prove beneficial to the warfighter.

"It might cost more in the beginning, but it is going to cost less in the long run because you are going to have to replace it less," he said.