Research chemists develop lighter, field repairable transparent armor

March 9 2017, by Daniel Parry

The NRL-developed transparent polymer armor consists of alternating layers of elastomeric polymer and a harder material substrate. Very small crystalline domains, which also provide rigidity, give the polymer its transparency. Credit: U.S. Naval Research Laboratory

Research chemists at U.S. Naval Research Laboratory (NRL) have developed and patented a transparent thermoplastic elastomer armor to reduce weight, inherent in most bullet-resistant glass, while maintaining superior ballistic properties.

Thermoplastic elastomers are soft, rubbery polymers converted by physical means, rather than a chemical process, to a solid. Consequently, the solidification is reversible and enables damaged armor surfaces to be repaired 'on-the-fly' in the field.

"Heating the material above the softening point, around 100 degrees Celsius, melts the small crystallites, enabling the fracture surfaces to meld together and reform via diffusion," said Dr. Mike Roland, senior scientist, NRL Soft Matter Physics. "This can be accomplished with a hot plate, akin to an iron, that molds the newly forming surface into a smooth, flat sheet with negligible effect on integrity."

Up to now, NRL scientists have tested the use of polymeric materials as a coating to achieve improved impact resistance of hard substrates. Applying polyurea and polyisobutylene layers enhance the ballistic performance of armor and helmets, and achieve greater ballistic effectiveness and mitigation of blast waves.

By using a variation of employing thermoplastic elastomers, NRL scientists are able to recreate superior ballistic properties of polyurea and polyisobutylene coatings, with the added benefit of the material being transparent, lighter than conventional bullet-resistant glass, and repairable.

"Because of the dissipative properties of the elastomer, the damage due to a projectile strike is limited to the impact locus. This means that the affect on visibility is almost inconsequential, and multi-hit protection is achieved," Roland said.

Provided by U.S. Naval Research Laboratory