Protective Equipment

Polymer Coating for Protection Against TBI, Enhanced Ballistic Performance, and Helmet Testing against IEDs and Close-in Explosive Charges

ONR continues funding NSWC Carderock Division and its joint CRADA with DuPont Corporation. This effort focuses on the application of polyuria (a high strain rate, high pressure sensitive polymer) with and without special inclusions, applied as coatings on helmet shells supplied by DuPont. A large series of close-in tests (54 separate cases) were performed on highly instrumented and helmeted manikins at the NSWC Carderock Division blast pit facility, and follow-on testing was completed at the NSWC Explosive Ordnance Disposal Technology Division against two large surrogate IEDs and an additional engineered IED configuration, which focused the blast energy more directly on the manikins. Test pressures for the IED tests were equivalent to those at the test pit, but the applied impulse was an order of magnitude higher. The blast pressures were oriented to the conventional Bowen injury curves, but the detailed intracranial exposure is being studied from a power-intensity aspect, combining impulse and acceleration levels. This relationship derives from a postulate published by Arthur E. Hirsch (David Taylor Model Basin, 1966) with respect to blunt trauma injury. The intent is to also explore crossover between the blast and blunt trauma exposure conditions. The helmets produced from the shells, which are fabricated with advanced ballistic fabrics, are weight-neutral compared to the conventional ACH and ECH after the coating is applied. The coatings were applied by Nanosonics Corporation of Virginia (spray-on) and by the NRL. In addition to testing the blast and ballistic mitigation capabilities of these coatings, testing was conducted to examine the capability of these coatings to suppress penetration from sharp-edged flechette-type devices. This testing showed that these coatings exhibited significant defeat capability on helmet-configured panels for this purpose. This has illustrated an added potential benefit of the coatings for special operations type environments. Results were verified against actual IEDs and several close-in explosive tests and using acceptable intracranial exposure levels, impulse, and acceleration criteria. The proposed polymer coated helmet exceeds MIL-STD ballistic requirements, while satisfying all other MIL-STDs. In addition, the coating, while enhancing the helmet performance for protection against mTBI, ballistic, and weight requirements, offers at the same time protection against sharp-edged flechette-type devices.