



US DEPARTMENT OF DEFENSE

BLAST INJURY RESEARCH PROGRAM COORDINATING OFFICE

Protective Equipment

Polymer Coating Protection against mTBI

ONR has continued funding researchers at the NRL to develop techniques for applying elastomeric polymer coatings with high strain rate sensitivity to combat helmets to improve on ballistic performance, and at the same time minimize mTBI. The NRL has been developing modifications of the ACH to address TBI that results from transfer of a blast wave through a helmeted head. The NRL has been substituting a portion of the resin used in the ACH with an active layer of material, comprised of a rate-sensitive polymer and hollow Silicon Carbide spheres. This active layer both dissipates the blast energy and disperses the blast wave. Tests were carried out over a range of blast pressures from moderate to severe (14-45 psi). The NRL designs attenuate the blast pressure transmitted through the helmet, providing reductions in acceleration of 41 percent and in velocity of 33 percent; commensurate decreases in displacement were also observed. These improvements were obtained with helmet (or equivalent panels) 10 percent lighter than the current ACH. Additionally, preliminary tests showed equivalent ballistic performance. mTBI injuries occur without skull fracture, potentially bruising the brain and damaging blood vessels and nerves. The damage mechanisms include acceleration (impact) and deformation (compression and shear) of the brain. However, the current detailed understanding, including subtleties in the coupling of the helmet, skull, and brain, is insufficient to allow correlation of brain injury to the characteristics of the blast wave. For this reason, it is necessary to focus our research on all measurable aspects of blast wave transmission through a helmet.