Ballistic performance of composite metal foams

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Abstract

The application of advance materials to manufacture hard armor systems has led to high performance ballistic protection. Due to its light-weight and high impact energy absorption capabilities, composite metal foams have shown good potential for applications as ballistic armor. A high-performance light-weight composite armor system has been manufactured using boron carbide ceramics as the strike face, composite metal foam processed by powder metallurgy technique as a bullet kinetic energy absorber interlayer, and aluminum 7075 or Kevlar™ panels as backplates with a total armor thickness less than 25 mm. The ballistic tolerance of this novel composite armor system has been evaluated against the 7.62 × 51 mm M80 and 7.62 × 63 mm M2 armor piercing projectiles according to U.S. National Institute of Justice (NIJ) standard 0101.06. The results showed that composite metal foams absorbed approximately 60–70% of the total kinetic energy of the projectile effectively and stopped both types of projectiles with less depth of penetration and backplate deformation than that specified in the NIJ 0101.06 standard guidelines. Finite element analysis was performed using Abaqus/Explicit to study the failure mechanisms and energy absorption of the armor system. The results showed close agreement between experimental and analytical results.

Keywords

- Composite metal foam;
- Dynamic loading;
- Hollow spheres;
- Powder metallurgy;
- Ballistics;
- Finite element analysis