Advanced Technologies for the Bonding and De-bonding of Armour Structures (ArmourBond)

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Background

Multilayer vehicular armour systems (Figure 1) typically consist of a combination of:

- **Cover layer (strike plate)**
  - Provides environmental protection and constrains the ceramic layer
- **Ceramic layer**
  - Blunts, erodes and decelerates the impacting projectile
- **Metallic or Composite (backing) layer**
  - Absorbs the remaining kinetic energy of the projectile (plastic deformation)
- **Adhesive layer**
  - Joins the different layers/ materials of the structure
  - Controls the stress wave propagation, induced by the impacting projectile, via transmission and reflection phenomena, governed by the acoustic impedance mismatch between the functional layers
  - Acts as a mechanical insulator [1-4]

![Figure 1. Example of a Multilayer Vehicular Armour System](image)

Project Aims

- Study the effect of material selection, design and surface treatment on the adhesion, the mechanical and the ballistic performance of the armour systems
- Propose better energy absorbing armour systems with improved shock wave attenuation properties
- Develop debonding-on-demand systems based on semiconducting, reinforcing fillers in the adhesive phase, via an Ohmic heating effect
- Upscaling and testing, up to STANAG level 4, in real armour packs, in collaboration with Permali Gloucester Ltd.

High Strain Rate Adhesives Mechanical Response

- The mechanical response of materials couples tested at high strain rates (Split Hopkinson Pressure Bar, Figure 2), using a range of different adhesives and adhesive thicknesses, was determined
- Specimens were consisted of a front and a back, adhesively bonded, Aluminium cylinders (Figure 3)
  - Al cylinder length: 4 mm
  - Al cylinder radius: 8 mm
- **Adhesive Types tested**
  - Two-component epoxy (adhA)
  - Polyurethane (adhB)
  - Silicone (adhC)
  - Toughened epoxy (adhD)
- **Adhesive thicknesses tested**
  - 0.25, 0.5, 1.0 and 2.0 mm

![Figure 2. Example of an SHPB configuration](image)

SHPB Results & Conclusions

- Figures 4 and 5 show that the reflection and the transmission of the impacting energy is greatly dependent on the adhesive type and thickness and, therefore, they should be carefully considered during the materials couples design

![Figure 3. Al Cylinder](image)

REFERENCES


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