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ABSTRACT:

Mechanical Behaviour of a Transparent Glass Fiber/Epoxy Composite

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In the modern era, the aerospace, automobile, and defense industries must integrate both superior mechanical properties and reduced weight into their designs. However, some structural elements such as windows or transparent ballistic protections (e.g. helmets and shields) must also possess satisfactory transparency, while retaining the previously mentioned properties and sufficient toughness. Composite materials can be a great candidate for these applications as long as they can offer suitable transparency.
In this work, a glass-fiber/epoxy composite material has been elaborated and mechanically characterized as a transparent composite shield. The composite material was fabricated using the resin transfer molding (RTM) process, resulting in a glass fiber epoxy plate. Specimens for the mechanical testing were prepared by water jet cutting and were subjected to tensile tests and laser-induced shock waves in order to determine the mechanical behavior of the material from low to high-velocity loadings. Specific diagnostics such as Photonic Doppler Velocimetry (PDV) have been employed during laser shots to record the free surface velocity of the composite material target. The recorded data were confronted with the target cross-section analysis in order to identify the delamination signature. Thus, a delamination threshold can be estimated and used to numerically replicate the experiments. These preliminary results provide encouraging results in the development of damage modeling of such a composite material under shock loadings.

Keywords: Shock wave, Pulsed laser, Delamination, Tensile test, Transparent composite