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Liquid Metal Embrittled Aluminum Alloy Material in Explosive Fragmentation and Shock Loading Conditions. JOHN RUDOLPHI, Sandia National Laboratories — Liquid metal embrittled (LME) aluminum alloy configurations were studied to characterize and investigate their behavior during explosive loading. Localized reductions in material strength, ductility, and toughness were created by the embrittling action of small quantities of gallium applied to aluminum. This study consisted of light gas gun experiments to quantify gallium-embrittled aluminum response to copper projectile impacts between 2.2 GPa and 18 GPa resulting in a P-u Hugoniot relationship. Microstructure conditions of tested material were characterized and indicate intergranular penetration by gallium into the aluminum alloy substrate. Embrittling agent quantity and exposure time were varied and quantified. In addition, aluminum alloy cylinders were packed with Composition C-4 explosive to observe natural fragmentation behavior in representative geometries. Some tests included a polycarbonate buffer between explosive and embrittled aluminum to induce a "low" pressure condition; all other tests were conducted with intimate explosive contact to the cylinder walls. Results indicate that embrittled aluminum cylinders fragment into significantly smaller particles compared to non-embrittled cylinders at both high and low pressure conditions. Microstructure analysis indicated brittle failure mechanisms in contrast to the highly-ductile failure of non-embrittled aluminum alloy.

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