

PROCEEDINGS

Dynamic Tensile Behavior of Al2024 and Al7050 Under Shock Loading

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ABSTRACT

Aluminum alloys 2024 and 7050 are widely used in aerospace structures due to their excellent strength-to-weight ratios. Under shock loading, these materials are susceptible to intense internal tensile stresses, which can lead to failure and structural damage. To investigate their dynamic response, plate-impact tests are performed on Al2024 and Al7050 specimens at impact velocities ranging from 300 to 600 m/s. Each alloy is tested in both the rolling (H) and transverse (V) orientations. Free-surface velocity histories are recorded using Photonic Doppler Velocimetry (PDV), from which characteristic pull-back signals associated with spall failure are extracted. The pull-back amplitude and strain rate are quantified to evaluate spall strength and failure evolution. Results indicate that Al7050 exhibits higher pull-back amplitudes and faster strain rates than Al2024 under comparable loading. In both orientations, the average spall strength of Al7050 is 1.1 to 1.2 times that of Al2024. Meanwhile, the average strain rate of Al7050 is 1.4 times that of Al2024. It suggests Al7050 has superior dynamic tensile strength and a more abrupt spall failure. Anisotropic dynamic response is evident, with H-oriented samples showing slightly higher amplitudes than V-oriented ones in the same alloy. When comparing the H orientation with the V orientation, the spall strength of Al2024 increase by ~28%, while that of Al7050 increase by ~19%. These findings underscore the importance of considering orientation-specific dynamic tensile behavior in the design of aerospace structures for high-velocity impact resistance, which is critical for ensuring structural safety and guiding material optimization under extreme conditions.

KEYWORDS

Aluminum alloys; spallation; shock; orientation; tensile behavior

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