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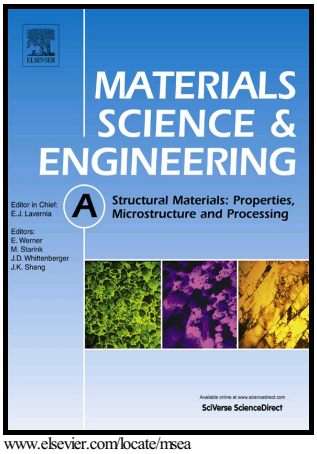

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Abstract:

Grain boundaries play an important role in the overall mechanical performance of metals and alloys; however, isolating the effects of individual grain boundaries remains rather challenging experimentally. In this work, wire-feed, electron beam additively manufactured tantalum is studied under shock loading conditions generating incipient spall damage. Three grain boundaries aligned parallel to the shock direction were isolated inside a single sample. Postmortem metallography showed voids preferentially appeared on two of the three grain boundaries which had high misorientation angles >30° compared to the third grain boundary with a relatively lower misorientation angle <10°. Nanoindentation in grain boundary regions for both pyramidal and spherical tips showed characteristically different strain hardening trends for each grain boundary. Significant local strain hardening is present on both sides of one high angle grain boundary, while strain softening is captured at the other high angle grain boundary. A negligible trend of either hardening or softening is shown in the vicinity of the single low angle