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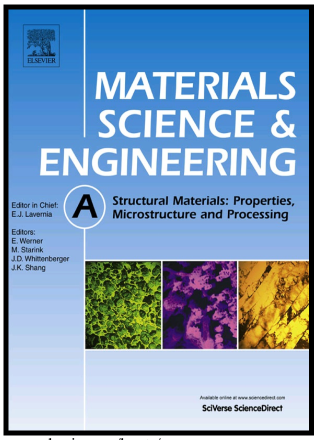

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PII: S0921-5093(18)30003-0
DOI: https://doi.org/10.1016/j.msea.2018.01.004
Reference: MSA35958

To appear in: *Materials Science & Engineering A*

Received date: 11 October 2017
Revised date: 31 December 2017
Accepted date: 2 January 2018

Cite this article as: B. Yu, K.H. Chien, K. Abu Samk and G.D. Hibbard, A Mechanism for Energy Absorption: Sequential Micro-kinking in Ceramic Reinforced Aluminum Alloy Lattices during Out-of-plane Compression, *Materials Science & Engineering A,* https://doi.org/10.1016/j.msea.2018.01.004

A Mechanism for Energy Absorption: Sequential Micro-kinking in Ceramic Reinforced Aluminum Alloy Lattices during Out-of-plane Compression

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Abstract

The current study examines the out-of-plane compressive response of ceramic/aluminum hybrid lattice materials with an anodic alumina outer shell and an aluminum alloy core. The combination of increasing truss angle and oxide coating thickness results in a six-fold increase in compressive strength, two-fold increase in densification strain, twelve-fold increase in energy absorption per volume, and twenty-fold increase in energy absorption per mass. Such improvements are caused by the change in failure mode from mid-strut buckling to a hinge kinking mode as the oxide coating thickness increases. Microscopy and analytical modelling reveal that kink formation is most likely initiated by aluminum shear band formation followed by oxide rotation and fracture (analogous to micro-kinking in fiber composites). In terms of energy absorption, the best performing lattice materials in the current study were on par with the best available cellular materials in existing literature.

Keywords: Porous material; Lattice structure; Ceramic metal composite; Mechanical property; Energy absorption; Analytical model

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