Abstract Submitted
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Laser Shock Compression Induced Reaction and Spalling of Reactive Ni-Al Laminate Composites[1] CHUNG-TING WEI, University of California, San Diego, BRIAN MADDOX, Lawrence Livermore National Laboratory, TIMOTHY WEIHS, Johns Hopkins University, VITALI NESTERENKO, MARC MEYERS, University of California, San Diego — Reactive laminates produced by rolling layers of Ni and Al (bilayer thicknesses of 8.3 and 48μm) were subjected to extreme laser loading. Laser energy was varied between ∼8.3 x 103J/cm2 (estimated initial pressure 140GPa) and ∼3.33 x 104J/cm2 (∼350GPa) with two initial durations: 3 and 8ns. Hydrodynamic calculations (HYADES) were used to predict propagation of shockwave in laminates. SEM and EDS were carried out to study the damage, failure modes, reaction propagation and spall. The 8.3μm bilayer thickness laminate exhibited localized interfacial reaction at 3.33 x 104J/cm2 laser energy; the reaction products were identified as NiAl and Al rich intermetallic compounds. The reactionfront forming intermetallic compounds propagated about 50μm into the sample with thinner bi-layer thickness (8.3μm). Estimated cooling rate was 5.7 x 105 K/s. The estimated highest temperature was about 1470K. Increase in the duration of laser shock wave induces increased reaction, which occurs also in the thicker bilayer laminate samples (48μm bi-layer thickness). The laser shock methodology is well suited to investigate the threshold conditions for dynamic mechanical reaction initiation.

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