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Microstructural Effects on Materials under Extreme Dynamic Environments CYRIL WILLIAMS, U.S. Army Research Laboratory — Studies have shown that microstructure and microstructure evolution can play a major role on the shock response of metals and metallic alloys. When metals and metallic alloys are deformed during shock compression, large numbers of lattice defects such as dislocations can be introduced in the material. These dislocations can lead to strengthening effects such as hardening and/or softening such as dynamic recovery which may consequently change the material behavior. Therefore, to better understand the effects of microstructure and microstructure evolution on the spall response of metals, both in-situ and end-state gas gun plate impact experiments were employed to study 1100-O aluminum. The results show a sharp increase in pullback velocity for 1100-O aluminum with increase in peak shock stress between 4.0 and 8.3 GPa due to shock hardening, followed by a decrease for peak shock stresses up to 12.0 GPa due to softening induced by dynamic recovery. addition, the effects of microstructure on the spall properties of two magnesium alloys fabricated via ECAE (AZ31B-4E) and SWAP (AMX602) were also investigated. The pullback velocities were found to decrease by approximately 15% for AZ31B-4E between 1.7 GPa to 4.6 GPa shock stress. On the contrary, the pullback velocities for AMX602 were found to be random for the same shock stress range studied. Residual microstructure of the post-shocked AZ31B-4E magnesium shows that aluminum-manganese intermetallic inclusions were perhaps responsible for the reduction in pullback velocity. Also, the post-shocked residual microstructure of the AMX602 magnesium revealed features that may have been responsible for its random response.

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