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On failure in polycrystalline and amorphous brittle materials[1]

NEIL BOURNE, AWE, Aldermaston

The response of brittle materials to uniaxial compressive shock loading is still not well understood. Describing the physical mechanisms resulting from the more complex triaxial states that result from impact and penetration is thus empirical. The physical interpretation of the yield point of brittle materials in one-dimensional strain (the Hugoniot elastic limit (HEL)), the rate dependence of this threshold, the form of stress histories and the effect of polycrystalline microstructure still remain to be comprehensively explained. However, evidence of failure occurring in glasses and ceramics behind a travelling front that follows a shock front has been accumulated and verified in several laboratories. Such a boundary has been called a failure front. The variations in properties across this front include complete loss of tensile strength, partial loss of shear strength, reduction in acoustic impedance, lowered sound speed and opacity to light. It is the object of this work to collect observations of these phenomena and their relation to failure and the HEL in brittle materials. Further, to relate these uniaxial strain measurements of their failed states to the depth of penetration (DoP) in the widely conducted test.

[1]In collaboration with Jeremy Millett, AWE, Aldermaston.