Shock-induced mechanochemistry in heterogeneous reactive powder mixtures

Manny Gonzales, Air Force Research Laboratory, Ashok Gurumurthy, Gregory Kennedy, Georgia Institute of Technology, Christopher Neel, Air Force Research Laboratory, Arun Gokhale, Naresh Thadhani, Georgia Institute of Technology — The bulk response of compacted powder mixtures subjected to high-strain-rate loading conditions in various configurations is manifested from behavior at the meso-scale. Simulations at the meso-scale can provide an additional confirmation of the possible origins of the observed response. This work investigates the bulk dynamic response of Ti+B+Al reactive powder mixtures under two extreme loading configurations – uniaxial stress and strain loading – leveraging highly-resolved in-situ measurements and meso-scale simulations. Modified rod-on-anvil impact tests on a reactive pellet demonstrate an optimized stoichiometry promoting reaction in Ti+B+Al. Encapsulated powders subjected to shock compression via flyer plate tests provide possible evidence of a shock-induced reaction at high pressures. Meso-scale simulations of the direct experimental configurations employing highly-resolved microstructural features of the Ti+B compacted mixture show complex inhomogeneous deformation responses and reveal the importance of meso-scale features such as particle size and morphology and their effects on the measured response.

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