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Effect of Particle Morphology on Critical Conditions for Shock-Initiated Reactions in Titanium-Silicon Powder Mixtures DAVID FROST, FRANCOIS JETTE, SAMUEL GOROSHIN, ANDREW HIGGINS, McGill University, JULIAN LEE, DRDC-Suffield — The effect of titanium particle morphology on the shock sensitivity of titanium-silicon powder mixtures has been investigated experimentally. The powder mixtures were tested in a planar recovery capsule, with the shock loading produced by a high explosive Tetryl booster charge placed on top of the capsule and a PMMA attenuator. Reactions were not observed for stoichiometric mixtures of large (75 – 106 μm), spherical Ti particles with fine ($<$ 44 μm) Si particles for incident peak shock pressures of up to 23 GPa, estimated with LS-DYNA. In contrast, mixtures with fine ($<$ 45 μm) spherical Ti particles or irregularly-shaped fine ($<$ 20 μm) Ti particles had critical shock pressures for reaction initiation of 7$\pm$3 GPa and 5$\pm$2 GPa, respectively. Microscopy and spectroscopy were used to identify the degree of intermixing between the particles for shock loading just below the reaction threshold. For the largest spherical Ti particles, little particle intermixing was evident. However, differential thermal analysis carried out demonstrated that even for the large Ti particles, shock loading of the samples generated microstructural effects which lowered the temperature for the onset of exothermic reaction of the shocked sample by about 80°C.

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