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High-Temperature and Pressure Aluminum Reactions in Carbon Dioxide Rich Post-Detonation Environments BRYCE TAPPAN, VIRGINIA MANNER, STEVEN PEMBERTON, MARK LIEBER, CARL JOHNSON, ERIC SANDERS, LANL — Powdered aluminum is a common additive to energetic materials, but little is understood regarding its reaction rate at very high temperatures and pressures in specific oxidizing gases such as carbon dioxide. Aluminum reaction kinetics in carbon dioxide have been studied in various reaction conditions, but difficulties arise in the more specific study of Al oxidation at the high pressures and temperatures in detonation reactions. To study these reactions, small particle size Al or the inert surrogate, LiF, was added to the energetic material benzotrifuroxan (BTF). BTF is a hydrogen-free material that selectively forms CO2 as the major oxidizing species for post-detonation Al oxidation. High-fidelity PDV measurements were utilized for early wall velocity expansion measurements in 12.7 mm copper cylinders. The JWL equation of state was solved to determine temperature, pressure and energies at specific time periods. A genetic algorithm was used in conjunction with a numerical simulation hydrocode, ALE3D, which enables the elucidation of aluminum reaction extent. By comparison of the Al oxidation with LiF, data indicate that Al oxidation occurs on an extremely fast time scale, beginning and completing between 1 and 25 microseconds. Unconfined, 6.4 mm diameter rate-sticks were also utilized to determine the effect of Al compared to LiF on detonation velocity.

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