

Aluminum Burn Rate Modifiers Based on Reactive Nanocomposite Powders

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Abstract

Aluminum powders have long been used in reactive materials for such applications as propellants, pyrotechnics and explosives. Aluminum has a high enthalpy of combustion but relatively low combustion rate. Addition of reactive nanocomposites can increase the burn rate of aluminum and thus the overall reaction rate. Replacing a small fraction of the fuel by a nanocomposite material can enhance the reaction rate with little change to the thermodynamic performance of the energetic formulation. This research showed the feasibility of the above concept using nanocomposite powders prepared by Arrested Reactive Milling (ARM), a scalable “top-down” technique for manufacturing reactive nanocomposite materials. The nanocomposite materials used in this study were 2B+Ti, and Al-rich 8Al+3CuO, and 8Al+MoO₃. The reactive nanocomposites were added to micron sized aluminum powder and the mixture was burned in a constant volume chamber. The combustion atmosphere was varied using oxygen, nitrogen, and methane. The resulting pressure traces were recorded and processed to compare different types and amounts of modifiers.