511c The Effect of Heating Rate on the Reaction Kinetics of Nanoscale Aluminothermic Reaction

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Recent experiments have shown that the heating rate can strongly influence the reaction behavior of nanocomposite thermite reactions. For heating rates up to 40 degrees/min, experimental results from thermal analysis using Differential Scanning Calorimetry and Thermal Gravametric Analysis (DSC/TGA) will be presented comparing nano and micron-scale aluminum particles mixed with crystalline nano-MoO3. For heating rates in excess of 1000 degrees/sec, we use single particle mass spectrometry to characterize the extent of oxidation. Results show that reaction characteristics such as ignition temperature (onset temperature), peak temperature, reaction duration and heat of reaction values vary as a function of heating rate. Experiments were also conducted with time-constant temperature programs to evaluate reaction momentum and isothermal temperature effects on reaction behavior. Data suggests that the diffusion controlled thermite reaction is heavily dependent on the thermal energy source and the rate of thermal heating to ignition. A conceptual model of the various reaction regimes will be presented.