Preparation and Performance of High Reactive Al-Mg-Zr Alloy Fuels with Intensive Heat Release

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Abstract: Ternary Al-Mg-Zr alloy fuels with Mg content ranging from 5% to 30% were prepared by a close-coupled gas atomization. The phase composition, morphology and exothermic oxidation behavior of the alloy powders were characterized by X-ray diffraction, scanning electron microscope(SEM) / energy dispersive spectrometer (EDS) and thermogravimetry-differential thermal analysis (TG-DTA) respectively and an oxidation reaction mechanism model was proposed to explain the intensive oxidation exothermic phenomenon. Results show that the alloy powders consist of Al, Al_3Mg_2, Al_3Zr and $Al_{12}Mg_{17}$ mainly, and the powder has good sphericity. With the increasing of Mg content, the oxidation reaction temperature of Al-Mg-Zr alloys decreases, the multi-step oxidation process gradually transforms into single step oxidation process and the energy releasing amount increases first and then decreases. The intensive exothermic oxidations of $Al_{78}Mg_{20}Zr_2$ and $Al_{73}Mg_{25}Zr_2$ powders occur at 945 ℃ and 938 ℃, respectively. The intensive oxidation reaction of $Al_{78}Mg_{20}Zr_2$ powder is relatively complete and the highest exothermic enthalpy of oxidation of the powder is 9798.8 $\mu V \cdot s \cdot mg^{-1}$.

Key words: Al-Mg-Zr; alloy fuels; intensive oxidation

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