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PRELIMINARY TEST ON MAGNESIUM-BASED ADDITIVE DOPED PARAFFIN FUEL FOR HYBRID ROCKET ENGINE

Abstract

A hybrid rocket engine combines advantages of liquid propellant rockets and solid propellant rocket. It uses propellants in different phases; usually, a combination of liquid oxidizer and solid fuel is utilized. The hybrid rocket engine is very safe, provides improved reliability in its operational process and is characterized by low fabrication and launch costs. With the aforementioned advantages, the hybrid rocket engine has drawn a lot of attention as a promising propulsion system for the future. Hybrid rocket fuel has a benefit to be able to include energetic additives during fuel casting. One of the objectives to add additives is to obtain improved rocket performance, such as specific impulse, density impulse and regress rate. The regression rate especially is considered a main issue in development of hybrid propulsion system. Performance-enhancing additives change thermal, chemical and mechanical properties of a solid fuel itself. An effect of the additives on characteristics of the fuel and rocket performance is dependent on various factors such as additive type, particle size, concentration of additive and fuel and oxidizer type. However, not all additive materials make a good result. There is a possibility test the additives introduce potential disadvantages. Therefore a research on doping of hybrid rocket fuel should be required comprehensive approaches over hybrid propulsion system and application. In this way, this study was carried out preliminary tests as an initial step to develop high performance hybrid rocket engine. In this research, paraffin and nitrous oxide are used as a fuel and an oxidizer, respectively. A commercial Magnesium Diboride powder(MgB2) as an additive is blended with paraffin fuel. It has advantages of stable and easy to handle. A doped fuel was conducted SEM(Scanning Electron Microscope) image analysis to confirm morphology and distribution of the fuel mixture. Furthermore, thermal, chemical, rheological and structural properties of doped fuels were presented depending on additive contents. For rocket performance evaluation, 1-kN hybrid motor firing tests were carried out with fabricated fuel mixture grains. The result showed difference in regression rate and combustion efficiency between pure paraffin and MgB2 doped paraffin.