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High entropy alloy as metal additive for hybrid rocket propellant

Arifah Binti Mohamad Jamil, Nur^a; Hadi Bin Mohamaddiah, Ahmad^b; Hanafi Bin Azami, Muhammad^a;

Hidayah Nordin, Norhuda^b

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^a Department of Mechanical & Aerospace Engineering, Kuliyyah of Engineering, International Islamic University Malaysia, Gombak, Kuala Lumpur, 53100, Malaysia

^b Department of Materials & Manufacturing Engineering, Kuliyyah of Engineering, International Islamic University Malaysia, Gombak, Kuala Lumpur, 53100, Malaysia

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Abstract

A typical solid propellant used in rocket propulsion systems is made from polymeric fuel, crystalline liquid binder and additives. In comparison to conventional propulsion systems, hybrid propulsion is more safe, reliable and environmentally friendly. However, the hybrid systems have some drawbacks, including low fuel regression rates and low combustion efficiency. As a result, several approaches have been developed to increase the rate of solid fuel regression rate including the introduction of metal additives to the system. Nowadays, high entropy alloys (HEA) are among the most advanced materials for high-performance applications. This alloy has a potential to replace the existing metal additives in hybrid propulsion systems. The present work proposes a new composition based on Paraffin wax fuel, loaded with high entropy alloy as a metal additive for hybrid propulsion systems using the following ratio of 80:20. Therefore, this research explores the efficacy of high entropy alloys as additives for hybrid propulsion systems. Characterizations and thermal analysis of solid fuel using X-ray diffraction (XRD), differential scanning calorimetry (DSC) and thermogravimetric analysis are carried out to determine the structure, thermal decomposition and energy characteristics of the solid fuel with the HEA as additive. XRD result shows that HEA in a form of solid solutions produces BCC and FCC structures. Thermal analysis of paraffin wax with the addition of HEA gives the maximum value of 136.34 J/g for the total latent heat of the mixture. It is concluded that HEA increases the energy released from the fuel by 86.92 % compared to pure paraffin wax fuel. The mixture of paraffin and HEA fuel has a prospect to be used as future rocket fuel. © 2022

Author keywords

High Entropy Alloys (HEA); Hybrid Rocket Propulsion; Metal Additives

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 Hidayah Nordin, N.; Department of Materials & Manufacturing Engineering, Kuliyyah of Engineering, International Islamic University Malaysia, Gombak, Kuala Lumpur, Malaysia; email:norhudahidayah@iium.edu.my

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