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PARAFFIN-BASED FUELS FILLED WITH LITHIUM-BASED ADDITIVES CHARACTERIZATION

Abstract

A new hybrid combustion test facility was developed at SPLab of Politecnico di Milano to investigate advanced paraffin-based fuels mixed with high energetic metal and metal hydride powders. This facility includes a gaseous oxygen feeding system, a pyrotechnic multiple system for re-ignition studies, a windowed chamber for high-speed flame visualization, pressure transducers for pressure measurements in pre-chamber and post-chamber, micro Pt-Pt/Rh thermocouples for the solid grain temperature profile measurement, and a mass flow controller suitable for transient firing tests.

In the second part of the paper the experimental set-up allowed characterizing a family of paraffin-based fuels filled with Lithium Aluminum hydride, Lithium hydride and Lithium amide in terms of regression rate and rheological properties, which affect the entrainment effect, prominent property to increase the regression rate of paraffin fuels. Obtained results show the important effects of powder mass fraction, catalyzers of hydrides decomposition and temperature on liquid melted fuel layer viscosity. Regression rate data, obtained with visualization techniques were compared to data obtained with probes for local and instantaneous regression rate measurements, showing a good agreement between the two techniques.

Further, the development of paraffin-based materials, used as high regression rate fuels for hybrid rocket engines, needs a deep investigation of the fuel surface pyrolysis processes and flame behavior. The measured regression rate and surface temperature allow obtaining data for the activation energy estimation and the following evaluation of global kinetic models. This third part of the paper complete the characterization of the investigated fuels.

References

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