SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic and Combined Cycle Propulsion (9)

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COMPREHENSIVE CONSIDERATION OF GELLED FUEL IN HYPERSONIC RAMJET PROPULSION

Abstract

The demand for high energy-density and improved safety fuels have led to an ever increasing research of gel fuels, which are interesting candidates for these broadened requirements both in the range of rocket and ramjet engines. In this particular semi-solid and semi-liquid state, these fuels combine the advantages of the solids with those of liquids. Gelled fuels are liquids whose rheological properties have been altered by the addition of gallants and, frequently, energetic solid additives so that they behave as non-Newtonian fluids. The unique viscoelastic properties of the gelled fuels enable them to store as solids, preventing leaks, while flow as liquids under pressure. However, the increased viscosity and existence of yield stress make gelled fuels more difficult to atomize and reach high combustion efficiency in engines, which is an obstacle to their wide use for aerospace application, especially for hypersonic ramjet propulsion. As an alternative to conventional solid or liquid hydrocarbon propellants, the use of gelled s a fuel for hypersonic ramjets is discussed in the present article. Firstly, the present paper re-examines the possibility of using gelled fuels for hypersonic ramjet propulsion. The analysis is based on detailed thermodynamic calculations which are used to calculate mass and volumetric specific impulse for several gelled fuel at different flight speeds, flight altitudes, and air/fuel equivalence ratios. And the theoretical calculations of gelled fuel performance are compared with those of conventional solid or liquid hydrocarbon propellants and pure powdered metal fuels. Secondly, key technologies of gelled fuel hypersonic ramjet propulsion for successful application are discussed, such as configuration of gelled fuel hypersonic ramjet propulsion, ignition and combustion of gelled fuel in high speed flows, et al. Especially, some novel solutions are discussed to make gelled fuels easier to atomize and reach high combustion efficiency in high speed flows.