

SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

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INVESTIGATION OF APPLICATION OF NANO-SIZED METAL POWDER AS FUEL IN RAMJET

Abstract

The general review is present of the application of metal powder as fuel in ramjet since high energy density and other attractive properties of metal fuel caught researchers' attention as early as late 1940's, when micron-sized metal powder was used. The poor dispersion technique and low combustion efficiency of micron-sized metal powder disappointed people to abandon this kind of concept. Nano-sized metal powder seems to be a progressing solution to these problems for its attractive merits such as large specific surface, high activity .etc, which inversely induces low metal content and difficulty for long time storing because nano-metal is too easy to react with oxidizer. The coating process, study of which in Russia, USA and China .etc is summarized in this paper too, could solve this problem, so it is critically important to study how to use what kind of material to coat and its effect on the chemical and thermal-physical properties of nano-sized metal powder, which, together with the combustion mechanism of coated nano-metal in the circumstance in ramjet, should become hot research fields for fuel or propellant researchers. The results could be used to solid ducted rocket and traditional SRM which is also discussed. In addition, the theoretical maximal load ratio of nano-sized metal powder in a given volume tank is attained in this paper, which possesses a critical effect on the real density of fuel to calculate the mass specific impulse and should be taken into account by designers of ramjet using metal powder as fuel. Another advantage of metal powder ramjet is the management of cold fuel compared with solid ducted rocket, which lower the difficulty to modulate the flow rate of fuel. The supply methods of nano-sized metal powder are discussed finally to look for a better solution to realize high flow rate modulation ratio. All in all, the problems on application of nano-sized metal powder as fuel in ramjet is investigated and discussed in this paper to attain several key research fields from a practical application perspective.