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PERFORMANCE AND ENVIRONMENTAL IMPACT PREDICTION OF SRMS. ROAD MAP FOR RELIABLE DATASET OF PARTICLES IN PLUME

Abstract

Aluminum is commonly added to solid propellants to increase the gravimetric specific impulse. However, the condensed combustion products (liquid and solid), deriving from aluminum incomplete combustion, are one of the main drawbacks of this solution, lowering the performances and contributing to pollution. In fact, on one hand, the thermal and kinetic inertia of the condensed combustion products lead to a specific impulse losses of about 10

It is worldwide known that the particles size plays a key role in the definition and in-depth comprehension of the previously described problems. However, since condensed particles experience a variety of phenomena while they are carried through the nozzle by the gaseous mixture (i.e., involving droplet breakup, condensation, evaporation, gas and surface phase reactions), it is not straightforward the definition of their overall impact on motor performances and environmental pollution. The large uncertainties in the state, size, and distribution of alumina can lead to inaccuracies in the prediction of plume conditions and its short- and long-term climatological impact.

It is clear that the expected increment of space access demand requires the proposal of new concepts upon the complex behavior of both the gaseous mixtures and the particulate phase and the overcoming of the presented lack of information. The present paper aims at describing a programmatic and unified framework of techniques describing the particles size evolution from the combustion chamber to the nozzle exit. The dataset can be used for the validation of numerical simulations, which, then, in turn, may be transferred to large scale SRMs.