INFLUENCE OF THERMO-ABLATIVE COMPOSITE MATERIAL DESIGN ON THEIR ABLATION RESISTANCE UNDER REPEATED IMPACTS OF LIQUID ALUMINA PARTICLES

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In a solid rocket motor (SRM), the use of aluminum enriched propellant results in the formation of alumina droplets that impinge on nozzle surface where they form a liquid film. Nozzles are composed of thermo-ablative composite material for thermal protection. However, they also have to mechanically and chemically resist to severe SRM environment.

An experimental simulation makes it possible to characterize and measure the surface recession of thermo-ablative composite under the impact of alumina droplets, and thus gets a better understanding of involved phenomena.

The experimental set-up involves two direct current plasma torches in a non-oxidizing controlled atmosphere chamber. They are used to melt and accelerate alumina particles. The surface recession measurements are carried out "in situ" by means of an optical control of sample position. Particle velocity and temperature are measured using an imaging technique and a fast two-color pyrometric technique, respectively.

The influence of carbon phenolic thermo-ablative material design on their ablation resistance under the impact of liquid alumina is studied. The design of the tested materials mainly differs in their carbon fiber structure and in the orientation of plies toward the surface exposed to alumina impacts. Ablation rate, thermal behavior and morphology of the tested sample are discussed. Mechanical and thermochemical effect due to alumina impacts and pyrolysis gases of the phenolic matrix are studied.

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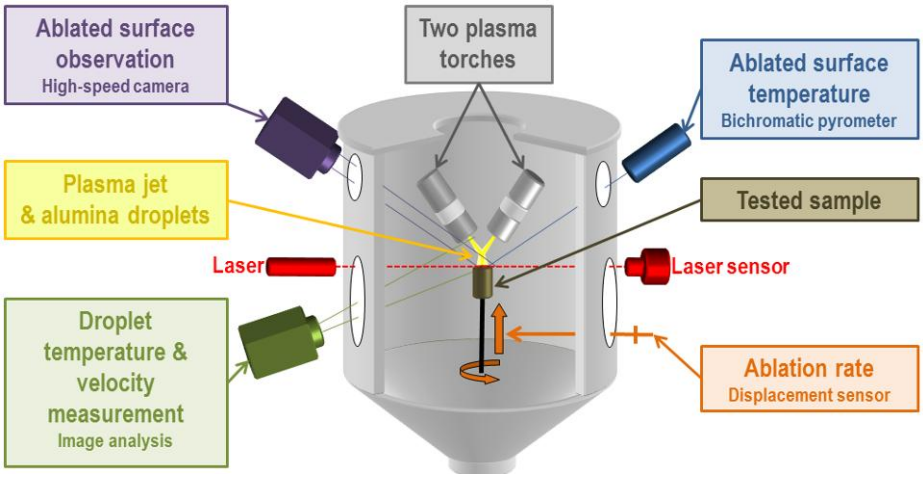

Experimental set-up

Plasma and droplets jets impacting a sample