VKI PLASMATRON JET INVESTIGATION FOR OFF-STAGNATION TESTING

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The increasing interest in space exploration and reusable space vehicles led to the need of deeply investigating the Thermal Protection System allowing this kind of spacecraft to re-enter in the earth atmosphere or in general to pass intact through an atmosphere.

The determination of the conditions in the off-stagnation region is nowadays of crucial importance especially for next reusable space vehicle thermal protection system validation. The von Karman Institute is studying plasma flows in the Plasmatron with the aim of being capable to design thermal protection systems for any kind of vehicle that should bear an atmospheric entry.

The Local Heat Flux Similarity concept, when applied to flat plate geometries, allows the experimental determination of the properties in the off-stagnation region. This testing methodology is applicable only in the case that a knowledge of the jet of plasma generated is possessed. Hence a characterization of the plasma jet produced by the Plasmatron is required.

Exploiting intrusive measurement techniques, measuring the heat flux at the stagnation line and the total pressure along the radial direction, the effects of the working parameters of the Plasmatron on the plasma jet behavior are investigated.

A wide experimental campaign was conducted making change the static pressure in the testing chamber, the mass flow rate and the power for two different positions of the probes. The physical properties and the chemical composition of the plasma jet under these conditions have been computed with the aim to find the tuning for the working parameters that could allow the insertion of a flat plate probe.

A comparison with available numerical simulations has been performed trying to understand if this tool could be exploitable for reliable prediction of the plasma jet behavior in the wind tunnel.

Some ranges of working conditions have been detected as potentially interesting for flat plate probe investigation purposes.

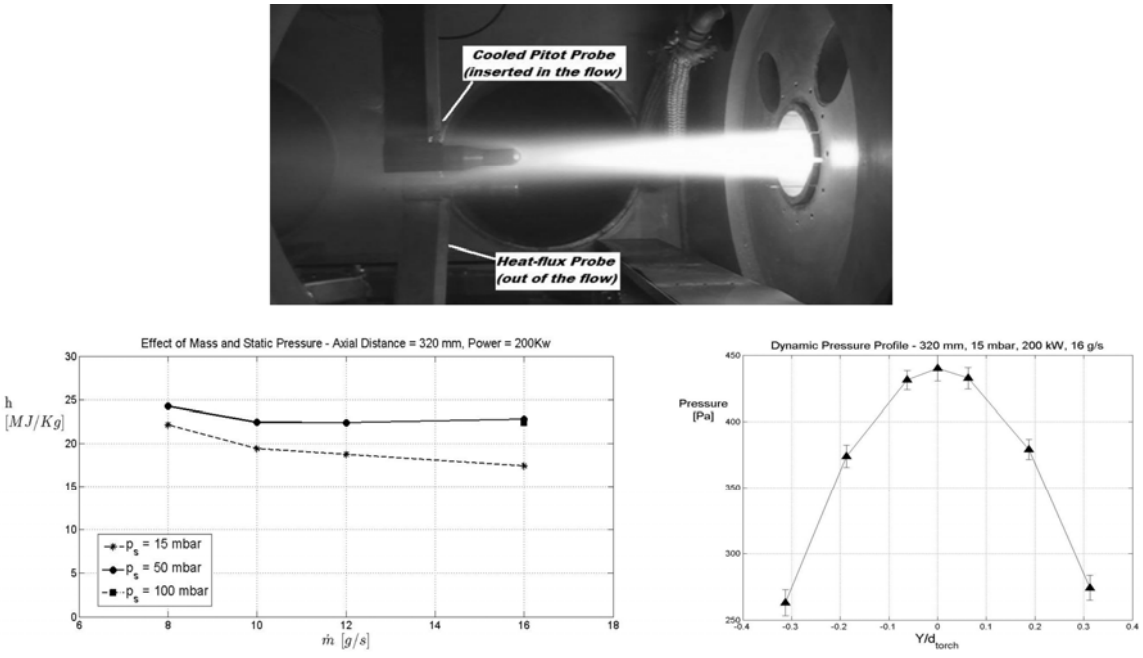

Figure 1: Plasmatron jet characterization: picture and data analysis