GROUND TEST INVESTIGATION ON A THERMAL PROTECTION SYSTEM JUNCTION

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During the atmospheric reentry of a space vehicle the dissociated flow around its Thermal Protection System (TPS) could travel from a low catalytic to a high catalytic surface. In this situation a peak of heat flux is experienced at the junction between the two materials. A safe vehicle design cannot preclude investigations on such a phenomenon, since the consequent heating could be harmful for the integrity of the TPS.

The present work finds its framework on the EXPERT (European eXPErimental Re-entry Testbed) project. The EXPERT vehicle TPS is composed of a C/SiC nose and a PM1000 skirt, so that a catalytic transition occurs in correspondence of their junction.

This project defines a suitable setup configuration for ground tests on wall catalysis phenomena over Thermal Protection Materials TPM). Experiments have been performed using the Von Karman Institute (VKI) induction-coupled plasma generator (Plasmatron), testing two different samples models. A high catalytic probe configuration, composed of an entire disk of HAYNES 214, is compared with a low-high catalytic configuration, composed of a central disk of C/C-SiC surrounded by a ring of HAYNES 214. The surface temperature of the samples is determined by means of an infrared (IR) camera, a pyrometer and thermocouples. Suitable test conditions in terms of pressure and surface temperature are chosen in agreement to the parameters calculated for representative real flight cases.

Emissivity and catalycity calculation are performed combining experimental measurements, providing temperature, heat flux and pressure and CFD solution of the Plasmatron environment, characterizing the boundary layer around the probe. The temperature jump occurring between the HAYNES 214 and the C/C-SiC is estimated, as well as the overshoot of HAYNES 214 temperature in the two configurations tested.

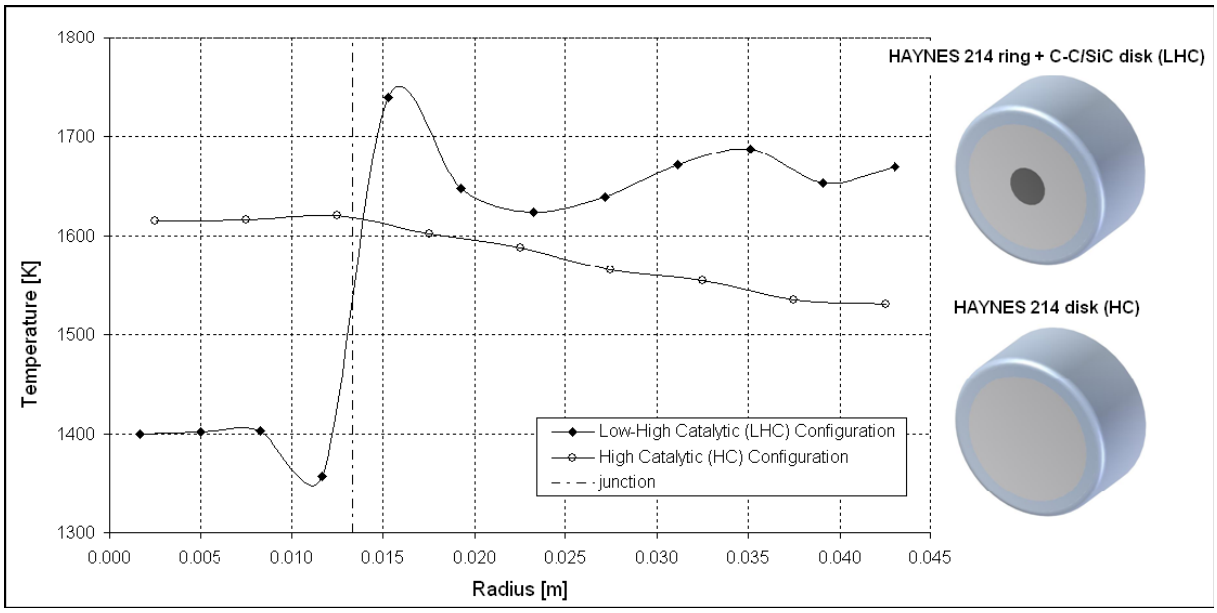

Figure 1: Radial distribution of the temperature over the two configurations tested in the Plasmatron