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CURRENTLY PERFORMED RESEARCH AND DEVELOPMENT ACTIVITIES IN THE FIELD OF ATMOSPHERIC ENTRY AT IRS

Abstract

An overview is given on activities within atmospheric entry. This covers the refurbishment, further development and new development of facilities. The refurbishments refer to modernization and extension of the IRS central vacuum system and the central power unit. For the plasma sources RD5 (high enthalpy MPD) and IPG3 (high enthalpy induction plasma source) upgrade designs were developed and set in operation. These sources have improved maintenance features and extended life times. EChamp a static facility to assess thermophysical properties and thermochemical behaviour concludes the list. MHD experiments are performed where the deal is the mitigation of heat fluxes due to influencing the boundary layer. The experiments in plasma wind tunnel 1 (PWK1) approved that heat flux mitigation but also local heat flux increase is possible depending on the magnetic field configuration. The experiments were flanked by electrostatic probes and OES in the B/L with and without magnetic field. A detailed post processing combined with a similarity approach in a reference cell, a static plasma facility, significantly contributed to an improved understanding. Here, the plasma was doped with dust particles used as plasma probes to separate forces experienced by the particles along their trajectories. This showed that the distribution of ions and electrons is a result of micro-field effects and ambipolar acceleration of the ions. For the well-characterized MHD conditions from PWK1 the IRS code SAMSA is used. One application of the PWK is characterization/ qualification of TPS. Progress has been made for catalysis. For the candidate materials for EXPERT the catalysis data base could be extended and even amended by the pressure dependency of the recombination coefficients. This also allowed the calibration improvement for the models of both TAU and URANUS. Within DLR@UniST cooperative research program, funded by Helmholtz Association, novel ablative heat shield materials and manufacturing processes were developed at DLR in Stuttgart with IRS, and were experimentally evaluated at IRS. The lightweight ablator ZURAM® constitutes an output of these activities and excels through simple manufacturing and high performance. ZURAM® comprises a carbon-fibre preform and a phenolic resin matrix. CFRP-based ablators by JAXA are investigated. This was extended towards the investigation of demisability, an activity, embedded in an ESA project where IRS investigates various candidate materials referring to their demising behaviour. Besides EXPERT, MIRIAM2 (catalytic based instrument PHLUX) and CAPE are references for flight experiments. In contrast to MIRIAM2, for which the FM is delivered, CAPE is still conceptual.