MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advanced Materials and Structures for High Temperature Applications (4)

Author: Prof.Dr. Georg Herdrich
Institute of Space Systems, Germany, herdrich@irs.uni-stuttgart.de

IRS RESEARCH AND DEVELOPMENT ACTIVITIES IN THE FIELD OF ATMOSPHERIC ENTRY

Abstract

An overview is given on activities in the field of atmospheric entry. This covers the refurbishment, further development and new development of facilities. Refurbishments cover modernization and extension of central vacuum system and the modernization of the central power unit. For the plasma sources RD5 (high enthalpy MPD) and IPG3 (high enthalpy induction plasma source) upgrade designs are set in operation. These new sources have improved maintenance features and offer extended life times. A compact light gas gun is developed and characterized able to perform tests for impacts. It can be hybridized with the miniaturized inductively heated source IPG6. MHD experiments and modelling are performed for electric space propulsion and atmospheric entry where the deal is the possible mitigation of heat fluxes due to influencing the boundary layer using magnetic fields. Respective experiments in IRS plasma wind tunnel 1 approved that heat flux mitigation but also local heat flux increase is possible depending on magnetic field configuration. A detailed post processing of these data combined with a similarity approach in a so-called reference cell, a static plasma facility, contributed to an increased understanding. This showed that the distribution of ions and electrons is a result of micro-field effects and the ambipolar acceleration of ions in the plasma could be visualised. For the characterized MHD conditions from PWK1 the IRS code SAMSA is in use. One further typical application of the PWT is characterization and qualification of TPS materials. Progress is made in the field of thermochemistry i.e. the determination of catalytic coefficients. For candidate materials for EXPERT e.g. the catalysis data base could be extended and even amended by the pressure dependency of recombination coefficients. This improved the calibration of finite rate models of TAU and URANUS. In the course of the DLR@UniST cooperative research program novel ablative heat shield materials and manufacturing processes were developed at DLR Stuttgart, and were experimentally evaluated at IRS. The lightweight ablator ZURAM® constitutes an output of these activities and excels through its simple manufacturing process and its good performance comparable to that of similar contemporary TPS materials as PICA and ASTERM. CFRP-based ablators by JAXA are characterized at IRS. This was extended towards investigation of CFRP demisability, an activity, embedded in an ESA project where IRS investigates materials with respect to demising behaviour and emissivity.