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# NEW ADVANCED CARBON-CARBON STRUCTURES FOR THERMAL PROTECTION SYSTEMS

**Abstract**

The whole international sector of space transportation is now involved in research and development of new technologies to build the next generation RLV (Reusable Launch Vehicles) capable to guarantee a safer, cheaper and frequent space transportation services. So, the space vehicle's thermal protection system (TPS) is one of the most expensive and critical systems of the vehicle. The goal of the present study is to develop an advanced structural solutions for the "hot structures" which should operate in aero-thermodynamic environment of typical re-entry conditions for reusable launch vehicle. The purpose of this work is to present a new technology developed for the production of Carbon Carbon (C/C) materials for TPS applications. In effect the C/C based on the impregnation and/or infiltration process have proven suitability under extreme thermo-mechanical environments in different structural parts like nose caps, nozzle jet vanes and engine flaps. In the last years considerable progress has been achieved to improve the manufacturing technologies of this materials, with very high costs. The C/C has good characteristics, particularly adapted to operate in these environments with high resistance, high elongation modulus, high mechanical property at high temperature and very low CTE. The key factor for using this kind of material is the high stability at high temperature, preserving its mechanical properties. Actually the production is provided by a densification process inside oven with inert gas, during the curing process. The goal is to obtain an innovative sandwich structure with C/C skin produced from a new process using new source material.

The innovative process used for the skin is obtained optimizing the pyrolysis cycles controlling both temperature and pressure. The combined action of temperature and pressure provides a good densification level for the resulting materials with better mechanical properties. The source matrix material is modified using SiC nanoparticles, directly added to the phenolic matrix by means of ultrasonication route, in order to improve the densification process as well as the thermo-mechanical properties of the final C/C composite. In order to validate the material, thermo-mechanical tests will be performed in accord to ASTM standard. These tests will be carried out referred to ECSS standard.

Index Terms — Carbon – Carbon, TPS, RLV, Thermal Cycles