Paper ID: 3765
student

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Vehicles – Mechanical/Thermal/Fluidic Systems (7)

Author: Mr. Slawomir Zdybski
International Space University (ISU), France

FUTURE DIRECTIONS OF MULTI-USE REENTRY THERMAL PROTECTION SYSTEMS FOR WINGED VEHICLES

Abstract

Reentry thermal protection systems (TPS) are one of the most challenging areas through which to improve transportation capabilities of reusable launch vehicles. Technological breakthroughs in these fields, enabling more efficient, durable, reliable and finally cheaper systems, could (if implemented) provide affordable access to space. Efficient reentry TPS, if technologically mature, would facilitate humanity's endless will to explore space and therefore lay strong foundations for the continued progress of mankind. In this paper the multiple use reentry TPS of the Space Shuttle and of the Buran vehicle are discussed and compared, particularly placement of the TPS elements, tile technology with re-waterproofing methods and protection of hot structures. Both vehicles' TPS performance is investigated in order to evaluate the systems and point out their weak points and limitations. Emphasis is put on technological solutions in the Soviet system that were introduced to diminish the main TPS problems of its American predecessor; that is high complexity of the system, its relatively low robustness with the recurring need for hydrophobic impregnation, and its long refurbishment process. Based on the experience of the two spacecrafts, requirements for advanced multi-use TPS for winged design vehicles are stated. In order to determine how far from fulfilling these requirements the space sector is, a study of current state-of-the-art achievements in the fields of material sciences and thermal protection is carried out. Special attention is given to Ultra-High Temperature Ceramics, Ceramic Matrix Composites and high performance Carbon-Carbon composites. This paper identifies and analyses research and development efforts in the aforementioned areas and recent technological accomplishments, which lead to the proposal of promising solutions for advanced thermal protection for future transportation systems.