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Author: Dr. Andrea Delfini
Sapienza University of Rome, Italy, andrea.delfini@uniroma1.it

Prof. Oleg Alifanov
Moscow Aviation Institute, Russian Federation, o.alifanov@yandex.ru
Prof. Aleksey V. Nenarokomov
Moscow Aviation Institute, Russian Federation, aleksey.nenarokomov@mai.ru
Mr. Sergey Budnik
Moscow Aviation Institute, Russian Federation, sbudnik@mail.ru
Dr. Alena V. Morzhukhina
Moscow Aviation Institute (National Research University, MAI), Russian Federation, morzhukhina@mai.ru
Mr. Dmitry M. Titov
Moscow Aviation Institute (State Technical University), Russian Federation, tdm@cosmos.com.ru
Dr. Marta Albano
Agenzia Spaziale Italiana (ASI), Italy, marta.albano@asi.it
Dr. Roberto Pastore
Sapienza University of Rome, Italy, roberto.pastore@uniroma1.it
Prof. Fabio Santoni
Sapienza University of Rome, Italy, fabio.santoni@uniroma1.it
Prof. Mario Marchetti
Sapienza University of Rome, Italy, mario.marchetti@uniroma1.it
Mr. Paolo Marzioli
Sapienza University of Rome, Italy, paolo.marzioli@uniroma1.it
Mr. Andrea Gianfermo
Sapienza University of Rome, Italy, andrea.gianfermo@gmail.com

THERMAL ANALYSIS OF ADVANCED CERAMIC COATING ON CARBON/CARBON SUBSTRATES FOR AEROSPACE RE-ENTRY RE-USABLE STRUCTURES

Abstract

Aim of the work is to analyze a novel coating process based on the ceramic varnish 'Pyropaint' applied on a TPS for re-entry application. The proposed treatment is due to preserve the thermo-mechanical properties of a Carbon/Carbon substrate from the detrimental space environment conditions, such as LEO thermal cycles, outgassing due to ultra-high vacuum, and Atomic Oxygen and UV irradiation. The first step is to analyze the coefficient of thermal expansion (CTE) by dilatometric measurement in order to evaluate the thermal stress of both the substrate and coating layer. Particular emphasis is devoted to the study of the effect of coating/substrate adhesion, which may result in anomalous mechanical behavior. Secondly, the manufactured assembly will be characterized in terms of thermal conductivity and thermal capacity by means of dedicated instrumentation. After thermal conditioning the specimens under test are investigated by full microscopy analysis using SEM/EDX techniques. The experimental results are then compared each other and with numerical simulations carried out by a mathematical modeling based on the inverse method. The present study paves the way for the future development of advanced structural

spacecraft panels as well as for re-usable re-entry systems.