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LOW ORBIT ENVIRONMENT EFFECTS ON CARBON/SIC COMPOSITES: EXPERIMENTAL AND NUMERICAL APPROACH

Abstract

The space environment is one of the most critical for space structures. The low earth orbit (LEO) space environment includes hazards such as atomic oxygen, UV radiation, ionizing radiation (electrons, protons), high vacuum etc. Exposure of composites to the space environment may result in different detrimental effects via modification of their chemical, electrical, thermal, optical and mechanical properties as well as surface erosion. The effects of different constituents of the space environment on spacecraft materials play an important role in determining the system function, reliability and lifetime. This is more crucial if the structure has to be used for the re-entry as thermal protection systems where the integrity of the surface and its coating is crucial for the success of the entire mission.During the re-entry, resistance of materials is hard tested by fast chemical reactions so that sublimation and ablation easily can take place. The key role played by C/SiC composites in re-entry environment is due to their high stability at high temperature, preserving their mechanical properties. For these reasons low orbit environmental tests such as outgassing and atomic oxygen are here presented focusing on the differences of the C/SiC behavior with and without the coating deposition. Moreover this effect will be studied also on the thermal characteristics which are fundamental for the design of such materials. But mathematical simulation is impossible if there is no true information available on the characteristics (properties) of objects analyzed. In the majority of cases in practice the direct measurement of materials thermo physical properties, especially of complex composition, is impossible. There is only one way which permits to overcome these complexities - the indirect measurement. Mathematically, such an approach is usually formulated as a solution of the inverse problem: through direct measurements of system's state (temperature, component concentration, etc.) define the properties of a system analyzed, for example, the materials thermophysical characteristics. Violation of cause-and-effect relations in the statement of these problems results in their correctness

in mathematical sense (i.e., the absence of existence, uniqueness, stability of the solution). Hence to solve such problems special methods are developed usually called regularized. The paper presents a joint experimental study on synergic effects on C/SiC composites. Outgassing and atomic oxygen corrosion are investigated by experimental tests. A correlation between these two phenomena and the variation in thermal properties of the C/SiC composites is studied by the means of the inverse method and SEM analysis