

Thermochemical Study of the Degradation of the Panels of Wings in a Space Shuttle by Utilization of HSC Chemistry Software and Its Database

Authors : Ahmed Ait Hou

Abstract : The wing leading edge and nose cone of the space shuttle are fabricated from a reinforced carbon/carbon material. This material attains its durability from a diffusion coating of silicon carbide (SiC) and a glass sealant. During re-entry into the atmosphere, this material is subject to an oxidizing high-temperature environment. The use of thermochemical calculations resulting at the HSC CHEMISTRY software and its database allows us to interpret the phenomena of oxidation and chloridation observed on the wing leading edge and nose cone of the space shuttle during its mission in space. First study is the monitoring of the oxidation reaction of SiC. It has been demonstrated that thermal oxidation of the SiC gives the two compounds SiO₂(s) and CO(g). In the extreme conditions of very low oxygen partial pressures and high temperatures, there is a reaction between SiC and SiO₂, leading to SiO(g) and CO(g). We had represented the phase stability diagram of Si-C-O system calculated by the use of the HSC Chemistry at 1300°C. The principal characteristic of this diagram of predominance is the line of SiC + SiO₂ coexistence. Second study is the monitoring of the chloridation reaction of SiC. The other problem encountered in addition to oxidation is the phenomenon of chloridation due to the presence of NaCl. Indeed, after many missions, the leading edge wing surfaces have exhibited small pinholes. We have used the HSC Chemistry database to analyze these various reactions. Our calculations concorde with the phenomena we announced in research work resulting in NASA LEWIS Research center.

Keywords : thermochemicals calculations, HSC software, oxidation and chloridation, wings in space

Conference Title : ICCETKA 2021 : International Conference on Chemical Engineering Thermodynamics and Kinetics Analysis

Conference Location : Jerusalem, Israel

Conference Dates : April 29-30, 2021