SIMULATION OF ATMOSPHERIC REENTRY IN CERAMIC MATERIALS IN A SUPERSONIC PLASMA WIND TUNNEL

III Congresso Online de Engenharia de Materiais. inscrições encerradas, 4ª edição, de 27/04/2021 a 30/04/2021
ISBN dos Anais: 978-65-89908-00-5

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RESUMO

Mullite is a ceramic composed of silicon oxide and aluminum used in various technological applications due to its physical and chemical properties, such as: Low thermal expansion, high thermal stability, low density, low thermal conductivity, good mechanical resistance and creep resistance, good stability in severe chemical environments, among other properties [1]. The supersonic plasma wind tunnel was optimized to investigate the ablative properties of the ceramic composite - Mullite (3 Al _2 O_3. 2SiO _2) deposited by the plasma spray process on Carbon - Carbon Substrate (C/C). The tests were performed at low pressure in a reactive air plasma using a DC non-transferred arc plasma torch with enthalpies of 7.2MJ / kg at 18.5MJ / kg and heat fluxes of 0.52 MW/m2 to 2.2 MW/m2 (Fig.1). The specific mass loss rate of the coated Mullite on the (C/C) was evaluated as a function of the exposure time and the heat flow. Microstructural and chemical analysis of the (C/C) substrate of the coated mullite before and after the ablation process through SEM / EDS were also performed. The mullite used in this experiment was processed by the Sol-gel method developed in the materials processing laboratory (PLASMAT-ITA), that is, a process involving a solution that passes through a transition called sol-gel and becomes gel by the and the basic objective of this technique is the preparation of a homogeneous precursor solution from which a semi - rigid gel with level of atomic homogeneity [1]. The synthesis of the mullite is obtained from the mixture in sol-gel of materials that present in its composition (Al _2 O_3) and (SiO _2). From the synthesis of the Mullite Sol-gel, it was inserted in a Plasma Spray process developed in the Thermal Plasma Laboratory (PLASMAT-ITA), where it was processed the coating of the Mullite in Carbon/Carbon substrate creating a layer of thermal protection on the substrate. The analysis of the obtained results showed that the adhesion of the mullite is directly related to the exposure time of the substrate (C/C) in the plasma spray process, in the formation of the coating as a protective layer, since the analysis of the rate of mass loss and (Fig. 2) showed that the mullite deposited on the surface of the (C/C) did not show good efficiency when this protective coating was submitted to the ablation process inside the supersonic plasma wind tunnel.

PALAVRAS-CHAVE: Reentry, Plasma Wind Tunnel, Simulation, Supersonic Plasma Torch

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