MAHATMA GANDHI INSTITUTE OF TECHNOLOGY

Department of MMT

INAE Innovative Student Projects Award Winners

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Title Of The Project: PREMLINIARY EVALUATION OF HIGH TEMPERATURE PROTECTIVE COATING FOR C_f-SiC COMPOSITE.

ABSTRACT

Carbon-fiber-reinforced SiC composites (C_f-SiC) are intended for use in high temperature structural applications, such as leading edges of wings and nose cones of hypersonic flight vehicles, where the temperatures are in excess of 1300°C. However, C_f-SiC composites undergo dimensional degradation due to oxidation at high temperatures, i.e. loss of C and Si from the composite occurs by the formation of gaseous CO, CO_2 and SiO. Therefore, the application of protective coatings is indispensable for the use of C_f-SiC in strategic high temperature applications.

The present study is aimed to develop suitable multi-layer high temperature protective coatings against high temperature oxidation of the C_f-SiC composite. Various multilayer high temperature protective coatings, comprising Si/mullite/yttrium silicate/yttria, were deposited on the composite using Atmospheric Plasma Spray (APS) technique. The thickness of the coatings was varied in the range between 100-500 µm. Cyclic oxidation tests of the coated composite were carried out in air at 1400°C and the relative oxidation performance evaluated. Microstructural and compositional analyses of the coatings have been carried out after the oxidation tests using scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS). The study revealed that the sequence of multilayer coatings had a significant effect on the oxidation performance. The best oxidation resistance was achieved for the multilayer coating which had Si as the inner layer, mullite and yttrium silicate as the successive intermediate layers, and yttria as the outer layer. On the other hand, the yttrium silicate coating exhibited the least oxidation resistance. The oxidation resistance offered by the various coatings are ranked as: 1. Si/mullite/yttrium silicate/yttria, 2. Si/mullite/yttrium silicate, 3. mullite/yttrium silicate/yttria, 4. mullite/yttrium silicate, and 5. yttrium silicate, in the decreasing order.