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MICROSTRUCTURES AND ABLATION BEHAVIORS OF CARBON/CARBON COMPOSITES UNDER AGGRESSIVE ABLATION ENVIRONMENTS IN A SOLID ROCKET MOTOR

Abstract

In this study the microstructures and ablation behaviors of the carbon/carbon composites under aggressive ablation environments are investigated by the hot firing test of a solid rocket motor. The morphologies of the ablation surface are studied by scanning electron microscopy and the ablation mechanism is also studied. Results show that after ablation for 22 s, the linear ablation rate reaches a maximum value of 0.061 mm/s. The carbon/carbon composites after ablation show different morphologies due to multiple aggressive ablation environments and controlling mechanisms. The carbon fiber microstructure is changed from truncated cylinder shape, axe head shape, cone shape to hollow truncated oblique cone shape with increasing effects of chemical ablation and reducing effects of mechanical erosion. And the matrix microstructure is changed from irregular shape to lamellar and shell shape. At mesoscale the fiber bundles are more resistant to chemical ablation than the matrix. At microscale the matrix is more resistant to mechanical erosion than the carbon fibers. An ablation model for the carbon/carbon composites is presented and couples chemical ablation and mechanical erosion.