Characterization of ablationproperties of carbon fiber reinforced composites with high enthalpy plasma windtunnel

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Aradioisotope thermoelectric generator (RTG) derives its energy from thespontaneous decay of radionuclides. RTGs have been used as a power source onvarious space missions. The power source must efficiently and reliably transferisotope decay heat to the conversion system while withstanding routine missionenvironments and postulated accident scenarios. Thermal protection system isnecessary to protect the power source under severe reentry conditions and toprovide impact protection against hard surfaces at its terminal velocity.

Carbonfiber reinforced composites have been used for thermal protection systems dueto their excellent resistance to oxidation and high thermomechanicalperformance. To evaluate ablation characteristics of materials exposed toextreme aerodynamic heating, Chonbuk National University (CBNU) a 0.4 MWsegmented arc heater plasma wind tunnel and VKI (von Karman institute for FluidDynamics) Plasmatron facility were used. We investigated the surfacetemperature, surface erosion rate, mass loss rate, and post-abrading surface ofthe specimens under the conditions of heat flux of 2, 3 MW/m^2.Carbon fiber reinforced composites were observed to have low mass loss and lowabrasion as their density increased. After ablation, the interface between thefiber bundle and the carbon substrate was clearly observed. It was also observedthat the pores after ablation were grown and crossed with a large crack betweenthe fiber bundle and the gap.