KAWASAKI STEEL TECHNICAL REPORT No. 23 October 1990

Development of Advanced Carbon-Carbon Composite for Spaceplane Application*

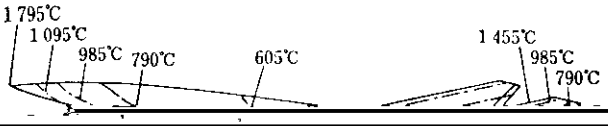
Synopsis:

Advanced carbon-carbon composites for spaceplane application have been developed which have high mechanical properties and good oxidation resistant coating. The C/C composites are reinforced with two dimensional car-

The 21st century will witness the development of com- growing space activity expected during and after the

able to take off and land horizontally. being conducted by each nation.

Several projects are currently under development; the **Photos 1** and **2** show conceptual illustrations of two



composites using a UD (uni-directional) structure, 2D structure or 3D structure as in the case with general resin matrix composites. **Table 1** gives a classification of

Table 2 Mechanical properties of the carbon-carbon

ture distribution on the Space Shuttle's surface during

Table 3 Techniques for ceramic coating

and so on and the surface of outer side of the tip fin will reach up to 1300°C, and those of the nose cap and wing's leading edges will reach up to 1600°C.[3] There

Ceramic/metal coating
Solution ceramic coating

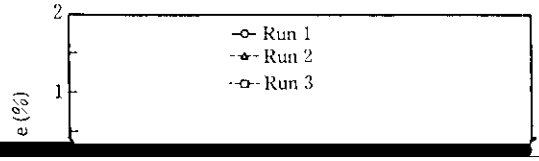
was coated upon the CVD-SiC layer. This viscous layer

fixed at the back of the specimen. The testing tempera-

CVD-SiC layer.

4.3 Anti-Oxidation Properties

repeated ten times for each specimen under an exposure time of 6 minutes per cycle. The weight and the thickness of the specimen were measured following



as attractive structural and oxidation protection materials for spaceplanes, especially HOPE. The following results were obtained:

(1) The present ACC reinforced with 2D carbon fiber