

RESEARCH OF THE CARBON/CARBON(C/C) NOZZLE

Huo Xiaoxu Liu honglin
The 43rd Academy Of The 4th Institute Of CASC. 710025

Introduction

The work of C/C nozzle are researched by more and more nations. In china, the work started at April, 1985. By a few years' hard work, the first step of work had finished. The reaserched C/C nozzle succed in static firing test.

Experimental

3D reinforced divergent section

The forming process was winding processing by using a computer controled winding mechine, then inserting carbon sticks. Using the process, the former,whose head and tail parts were 4D, the middle part was 3D, was made. After forming, the densification processes were done. (e.g Figure 1.)

The properties of the last product see table 1.

C/C intergrated throat entrance(ITE)

The structure's of ITE include the convergent section and the throat. The research work used the technologies of the 4D C/C throat. What the diffrence was that the ITE is 5D C/C. The densification processes was same and the last product's density was 1.81 g/cm³.

The attachment of ITE and C/C divergent section

The attachment type of them was screw thread structure. The structure was tested that it was workable and reliable. The attachment type made the ITE and C/C divergent section changed a better integrad. The ITE beared part of the impact load coming from divergent section, which reduced the bearing load of the insulation section.

Introduction of the firing test

Parameters of the firing test:

Diameter of the throat: ϕ 83mm
Average pressure of the chamber: 3434.16Mpa
Intra-diameter of the exit section of the throat:
561.35mm

During the firing test, the total time was 39.571s. In-suit video and display were made. The motor worked nomnaly. The out-surface of the divergent section was burning-red. The insulation section didn't fire. There were not worried problems in the motor and nozzle during the 39.571s.

Analysis of the firing test's results

After testing, the ITE's structure and the attachment of screw thread were still in good condition.

There was some carbon black on the interface of the C/C divergent section and the ITE. It is the remnant of the glue which was used as sealed material between the C/C divergence section and the ITE.

The dimension of the minmum diameter of the divergent section wasn't changed. It showed that the material beared erosion, and it's density was lower than CFRP.

It was the worriest place on the exit section of the divegent section. But on the thinnest place (0.9mm), it was as good as before. It showed that in the condition of 1000m/s air current rate,20910N thrust load, the strength of the material was enough.

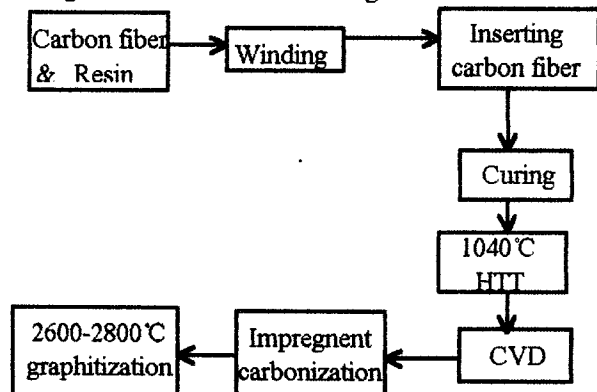


Figure 1. C/C divergent section forming process

Properties	Results
Density g/cm ³	1.64
Strech strength MPa	23.2
Bending strength MPa	121.9
Bending module GPa	23.24
Degree of graphitization %	79.0

Table 1. The properties of the last product

Acknowledgment

Thanks our co-worker to help me finishing the reaserch work.

Reference