

RESEARCH OF THE TOUGHNESS OF CARBON/CARBON(C/C) COMPOSITE MATERIAL

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Introduction

C/C composite is normally considered as a brittle material, which has a lower failure strain (1%). The purpose of this study is to make a composite material with some properties of toughness and recovering by improving and increasing the capacity of bending resistance, deflection and other mechanical properties, which can be obtained by changing the forms of the reinforcement (2D carbon cloth or non-wovt cloth) and modifying of the matrix (to add to some additives such as flexible graphite, graphite powder).

Experimental

Raw matirials

Reinforcements:

2D carbon cloth(PAN 6K & 3K,made in Jilin carbon factory,china)

non-wovt cloth(made by 3K PAN carbon fiber)

Additives:

flexible graphite($0.047\text{g}/\text{cm}^3$ of density)

graphite powder (chemical reagent)

Adhesive:

high temperature coal-pitch(65% of carbon content)

lower-press barium phenol-formaldehyde(41% of carbon content)

furfural resin,phosphoric acid as curing agent
(68.8% of carbon content)

Processes

We get the material through under processes(see figure 1.).

During the processes, the material is be made mainly by hot -press and CVD. The reinforcements are treated at 1000°C .

Results and Discussion

In the research, orthonomal and contrastive experiments are be used. So the optimum fabrication method of the C/C can be obtained. In next descriptions. The effect of all kinds of factors on the toughness of the matrial will be discussed.

Figure 2. shows the factors, such as the kinds of the resin adhesives, the volume fraction of carbon fibers, the percent of additives to all of the matrix and the ratio of additives (graphite powder:flexible graphite) ,effect the failure strain and maximum bending stress.

From figure 2. , we can see that the volume fraction of carbon fibers and the quatities of additives to matrix are more important factors to increase the maximum bending strength. The effect of the type of adhesives and the ration of graphite powder to flexible graphite on the failure deformation are more important.

Table 1.shows 2D carbon cloth and non-wovt cloth effect on the toughness of c/c composite.

From table 1. ,we think that c/c composite reinforced by 2D carbon cloth has higher toughness than by non-wovt cloth. But it has lower bending strength and bending modulus.

Table 2. shows the wthether carbon cloth treated by heat effects on the toughness.of the material.

Form table 2. when the carbon cloth treated by heat ,the bending strength,bending modulus and maximum strain are increased. So we think that the heat-treatment to carbon cloth is a better method to increase the toughness of c/c composite.

Conclusion

Finally, an higher toughness C/C composite has been obtained. It has excellent properties, such as the density $1.3 \sim 1.5\text{g}/\text{cm}^3$, failure deformation ration 1.8%(3-point bending test),bent strength 170MPa and bent modulus 30GPa. The optimum fabrication method

is phenol-formaldehyde resin as adhesive, graphite powder and flexible graphite as additive whose mixture ratio is 5:1(weight ratio)and whose total weight is 20 percent of the matrix weight, carbon cloth as reinforcement which has been high-temperature treated and whose total volume fraction should be controlled within 20 ~ 40%.

Acknowledgment

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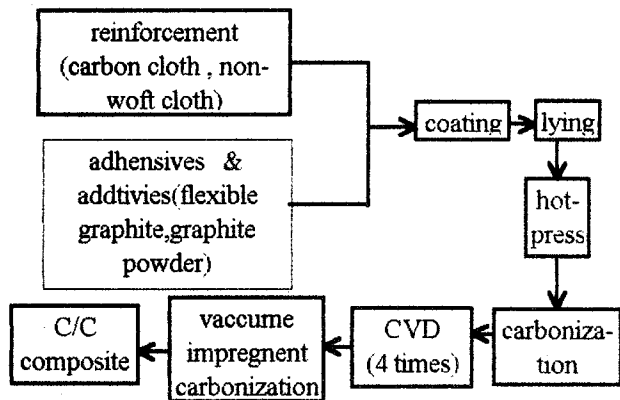


Figure 1. Process of the c/c composite with higher toughness

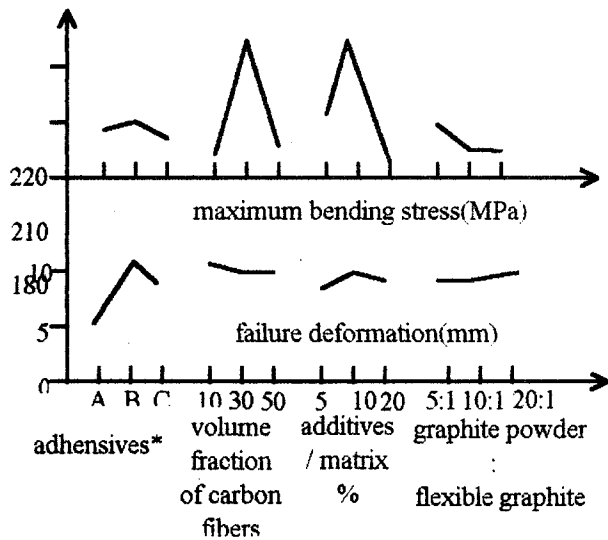


Figure 2. Results of the orthonormal experiments

* A---pitch B-- phenol-formaldehyde resin
C--furfural resin

reinforcement	2D carbon cloth	non-woven cloth
result		
bending strength (MPa)	170.00	309.40
bending modulus(GPa)	30.00	46.60
maximum strain (%)	1.8	0.8

Table 1. The effect of the types of reinforcement on c/c composite

reinforcement	2D carbon cloth(6K)		2D carbon cloth(3K)	
	Y	N	Y	N
bending strength (MPa)	157.60	118.40	169.00	61.08
bending modulus (GPa)	24.66	24.70	22.44	29.23
maximum strain (%)	1.04	0.59	1.45	0.26

Table 2. The effect of heat treatment on the toughness of c/c composite

* whether be the carbon cloth heat-treated?

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