FABRICATION OF PAN-BASED SUPERTHICK CARBON FELT

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Introduction

Carbon-carbon composites, used as rocket nozzle throat due to high specific strength, good ablative and thermal shock resistance, are generally fabricated from carbon preforms infiltrated and densified by either gas- or liquid-phase impregnation. Obviously, their properties are to a great extent controlled by the nature of the carbon matrix. Therefor, it is important to select suitable materials as preform matrix. With the purpose of it, superthick carbon felts of more than 250mm thick have been developed. They are made from PAN fibre with the following processes. At first, PAN fibre must be oxidized into flame resisting one, then cut to desired length and carded to net sheets, followed by felted via stacking and interweaving, finally, carbonized. Among them, the oxidation process was focused attention on in this paper.

Experimental

PAN fibre, manufactured by Lanzhou Chemical Fibres Plant, was used in this study. Oxidation treatments were carried out at 260, 280 and 300℃ respectively. During processes, a certain tension was put on fibres in order for resistance to shrink. Differential thermal analyses were performed using Model 4.1 Precision Differential THermal Balance made in China. The results are shown in Fiqure 1. Whereas Table 1 summarized oxygen contents determined by chemical method. Oxidized PAN fibres were then used for fabricating superthick carbon felt.

The objective of this study is to investigate the relationship between the process parameters and carbon felt quality, so as to determine the best suitable technological process.

Discussion

It is well known that transformation of PAN fibres to good quality carbon fibres requires an essential oxidation step prior to cabronization[1]. In this oxidation process, the colour of fibres was gradually changed from white to yellow, brown, finally to black which indicated microstructure transformation taking place. Molecular chains of PAN fibres were converted to ladder structures via cyclization and polymerization, along with dehydrogenation reactions.

Fiqure 1 shows that the exothermic peak of oxidized fibres at 300℃ is the lowest and unoxidized fibres the highest, which express to a certain the degree of thermal stabilization. Fibres of unoxidized and oxidized at lower temperatures are easy to cause combustion during carbonization, and on the other hand oxidized fibres at higher temperatures can result in decrease in strength. In addition, certain molecules of oxygen were linked up on the carbon backbone of fibres. As a result, oxygen contents of oxidized fibres were increased shown in Table 1. It is believed that the oxygen content of about 10 per cent is applicable[2].

Conclusions

Oxidation program, which has direct influence on felting, has been set up through oxidation experiments as mentioned above. On the basis of it, advanced superthick carbon felts have been fabricated in batches, their typical characteristics are as follows, bulk density is 0.20 g/cm , tensile strength(x-y) 0.5 MPa, whereas tensile strength(z) 0.03 MPa, carbon content is 95 per cent.

References

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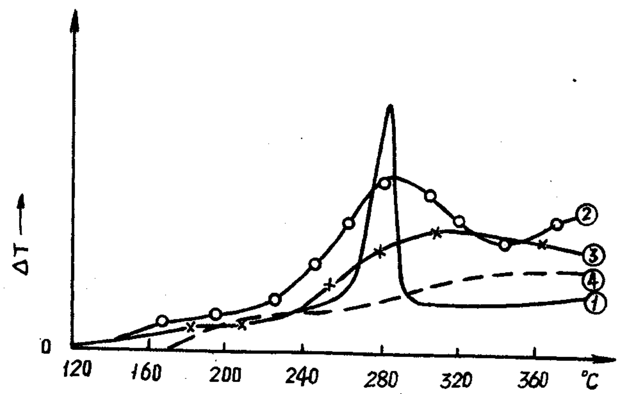

Differential thermal analyses of PAN fibres

(1) unoxidized;

(2), (3), (4) oxidized at 260, 280 and 300℃ expectively

Table 1 Elemental Analyses of Oxidized PAN fibres (wt%)

oxid. temp. ℃	C	N	H	O	moisture	Ash
260	61.38	21.38	4.70	8.58	2.63	0.84
280	61.09	20.94	3.90	9.80	3.49	0.78
300	58.25	20.08	3.83	12.57	4.53	0.80