

# OXIDATION PROPERTIES OF HIGH MODULUS CARBON FIBER

Xuejun Zhang, Zengmin Shen, Yanhong Tian, Xiping Zhang, Weiqin Zhang,  
Yanfeng Yang, Xiaosong Zhang, Hanchang Chen  
*Institute of Carbon Fiber and Composites*  
*Beijing University of Chemical Technology, Beijing 100029, P.R.China*

## Introduction

Carbon fiber and composites are widely used in many fields, such as rocket nozzles, re-entry shields of space vehicles, and so on. In such systems, oxidation of carbon materials is one big problem which should be considered and resolved. There are many ways to improve the resistance of carbon material towards air oxidation, and several additives can lower the reactivity of carbon with oxygen[1-5]. One simple way is to make carbon fiber go through heat-treatment under higher temperature to form graphite-like structure, which has less active surface and is less susceptible to oxidation than carbon fiber. In this paper, oxidation property of high modulus carbon fiber was studied.

## Experimental

PAN-based carbon fiber was heat-treated at 2873K, and oxidation properties of the resultant high modulus carbon fiber and as received carbon fiber were characterized by TG method from 293K to 1173K at rate of 10 K/min. The oxidation behavior of rayon-based carbon fibers at the same temperature range was used as comparison. The metal, especially K, Na, contents of these carbon fibers were measured by atomic adsorption spectrum.

## Results and discussion

The TG curves of PAN-based carbon fiber with and without high temperature heat treatment were shown in Figure 1 and Figure 2, respectively. Figure 3, which is as reference, was the TG curve of Rayon-based carbon fiber. The metal content of these fibers were shown in Table 1.

Table 1. Metal content of carbon fibers

Sample	K (wt %)	Na (wt %)
PAN-based high modulus carbon fiber	0.0082	0.0039
PAN-based carbon fiber	0.0071	0.0086
Rayon-based carbon fiber	0.0085	0.0048

From table 1, we can see that Na content is decreased after high temperature

heat-treatment. As to TG curves, the results show that high modulus carbon fiber start to have weight loss at 437K and have a yield of 94.8% at 744K. The weight loss is 25.5% at 963K. Among these three carbon fibers, high modulus carbon fiber has the lower weight loss at the same temperature, which is due to . The metal content of high modulus carbon fiber is also lower than those of the rayon-based carbon fiber, which also contribute to the good anti-oxidation property of high modulus carbon fiber.

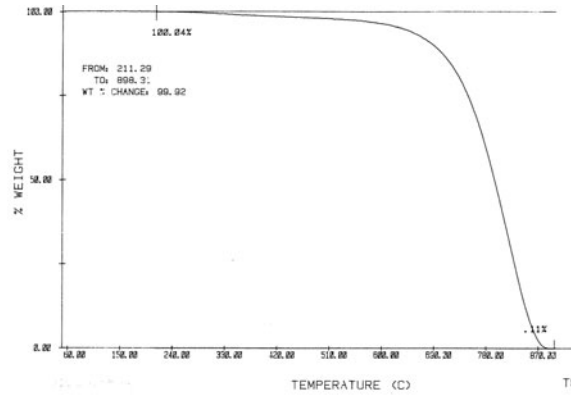


Figure 1. TG curve of PAN-based high modulus carbon fiber

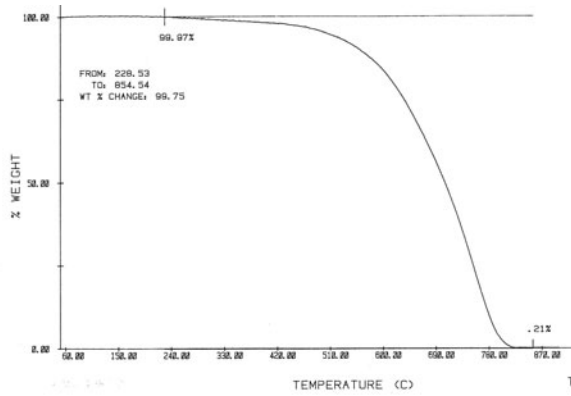


Figure 2. TG curve of PAN-based carbon fiber

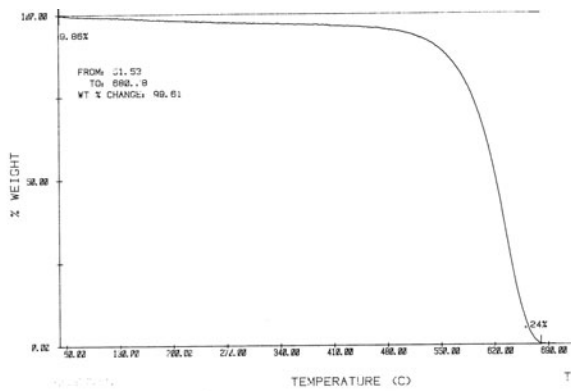


Figure 3. TG curve of Rayon-based carbon fiber

## **Conclusions**

The metal content of carbon fiber decreased after high temperature heat treatment. Compared with Rayon-based carbon fiber, PAN-based carbon fiber with high modulus has good anti-oxidation property.

## **References**

- [1] Piquero T, Vincent H, Vincent C, Bouix J. Influence of carbide coatings on the oxidation behavior of carbon fibers. *Carbon* 1995; 33(4): 455-467.
- [2] Harris M, Laine RM, Chaudhary T, Drzal L. Silicon oxycarbide coatings on graphite fibers: Chemistry, Processing, and Oxidation resistance. *Materials Science and Engineering: A* 1995; 195: 223-236.
- [3] Sogabe T, Okada O, Kuroda K, Inagaki M. Improvement in properties and oxidation resistance of carbon materials by boron oxide impregnation. *Carbon* 1997; 35(1): 67-72.
- [4] Lu W, Chung DDL. Oxidation protection of carbon materials by acid phosphate impregnation. *Carbon* 2002; 40(8): 1249-1254.
- [5] Howe JY, Jones LE. Influence of boron on structure and oxidation behavior of graphite fiber, P120. *Carbon* 2004; 42(3): 461-467.