

OXIDATION RESISTANCE OF B₄C-SiC/C COMPOSITES

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Introduction

Although carbon materials possess uniquely superior properties, their application fields are limited for they can be easily oxidized and then lose their original performance in oxidative atmosphere at high temperatures above 500 °C. Much effort has been done in attempt to improve oxidation resistance of carbonaceous material at elevated temperatures [1,2]. One of the way to improve oxidation resistance is by mean of adding nonoxide ceramic powder into carbon matrix and fabricating ceramic/carbon composites [3,4]. When the composites were exposed in oxidizing atmosphere, the oxidation was retarded by a diffusion barrier of glassy oxide layer on the surface of the composites. B₄C-SiC/C composites have been found to possess an excellent inhibitory effect against air oxidation at temperatures above 1000 °C [5] due to the formation of borosilicate (B₂O₃-SiO₂) coating on the surface of the composites [6].

In the present study, oxidation resistance of B₄C-SiC/C composites with various B/Si ratio in dry air at 1200 °C was investigated and preliminarily discussed. Oxidation resistance of B₄C-SiC/C composites in wet air was also tested.

Experimental

B₄C-SiC/C composites were fabricated by mean of mixing and long time grinding methods [7]. Table 1

shows the composition of the starting materials for fabrication of the composites. All composites were cut into samples with the size of 10 × 10 × 10 mm and were subsequently oxidized at 1200 °C under the dry air flow rate of 2L/min. In order to investigate the effect of moisture on oxidation resistance of B₄C-SiC/C composites, samples of BS1530 were also to be oxidized at moist air (R_H=0.8). Oxidation resistance of the composites was estimated by weight change after oxidation at 1200 °C for 1-5 hours.

Tab. 1. Composition of starting materials for fabrication of the composites and B/Si ratios

	Carbon	B ₄ C	Si	B/Si
	(wt%)			ratio(mole)
BS2010	70	20	10	4.31
BS2020	60	20	20	2.15
BS1530	55	15	30	1.08

Results and Discussion

Fig 1. shows weight loss of the composites during oxidation at 1200 °C with the dry air flow rate of 2l/min. All composites showed good oxidation resistance because borosilicate (B₂O₃-SiO₂) coating formed on the surface of the composites, while there are some differences in oxidation resistance among these composites, which were mainly due to the

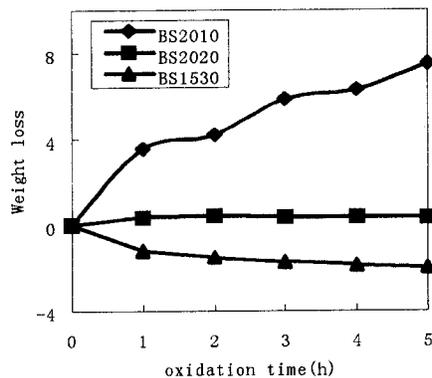


Fig.1. Weight loss with time of the composites oxidized at 1200 °C.

nature of the oxide layer formed on the surface of the composites. In the case of the composite (BS2010) with the highest B/Si ratio, B₂O₃-rich borosilicate layer was liquid and its viscosity was low [8], therefore oxygen could diffuse through the oxide layer into the interior of the composite and oxidize carbon matrix; For the composite (BS2020) with lower B/Si ratio, the surface of the composite was covered with a highly viscous borosilicate layer forming a diffusion barrier and greatly retarding air oxidation, therefore weight loss of the composite was small; As a consequence of the lowest B/Si ratio, the surface of the composite (BS1530) was covered with a smooth and dense glassy oxide layer, therefore weight gain (due to the formation of B₂O₃-SiO₂) of the composite could be observed, as indicated in Fig 1.

Fig 2. shows that weight gain of BS1530 oxidized at moist air is higher than that at dry air. It demonstrates that the composite still has excellent oxidation resistance even at the moist air. At high temperature up to 1200 °C, water steam in air will decompose into hydrogen and oxygen. The higher partial pressure of oxygen in oxidizing atmosphere could accelerate the formation of borosilicate layer which acted as a diffusion barrier preventing carbon matrix from being oxidized further on and the glassy layer on the surface of the composite was of a dense

texture.

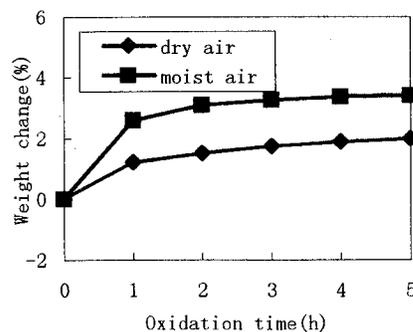


Fig.2. Weight change with time of BS1530 oxidized at different atmosphere

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