

MEASUREMENT OF EXOTHERMIC REACTION TEMPERATURE DURING REACTIVE MELT INFILTRATION PROCESS

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In the Reactive Melt Infiltration (RMI) method, a SiC matrix is formed by immersing the preform into molten Si and reacting the molten Si with C inside the preform. The RMI method can form a dense matrix quickly.

However, the reaction of

$\text{Si} + \text{C} \rightarrow \text{SiC}$ is exothermic so that the temperature of preform rises. When the temperature of the preform rises, the fibers may be damaged, so it is necessary to suppress the temperature rise during reaction.

The following three factors are considered to affect the amount of heat generated per unit time.

i) Large pore size in the preform

The permeation velocity dh / dt can be obtained from the washburn equation as follows.

$$\frac{dh}{dt} = \frac{R\gamma\cos\theta}{4\eta} \cdot \frac{1}{h} \quad (1)$$

where: h: Liquid penetration height, R: Radius of holes, γ : Surface tension of Si, η : viscosity, t: time

From Eq. (1), it can be seen that as the diameter of the pores increases, the permeation rate also increases, so the amount of heat generated per unit time increases.

ii) A large amount of C in the preform



iii) Large supply of molten Si

Among these factors, we focused on iii).

The preform was impregnated by the following two methods.

The preform is impregnated with molten Si. (method A).

The other was placed with the preform in contact with the granular Si before melting (method B).

When impregnated with molten Si, temperature rise (ΔT) was higher than 146 °C, but when impregnated using granular Si,

$\Delta T = 91$ °C, which was effective in controlling the temperature. When impregnated with completely melted Si, Si is supplied quickly, and more $\text{Si} + \text{C} \rightarrow \text{SiC}$ reactions per unit time should occur. However, in the case of granular Si, if it is impregnated gradually with the molten Si, it reacts slowly over a long period of time, so it is considered that the temperature rise can be suppressed. In fact, using this method, temperature rise of the preform could be suppressed to 50 °C or less.

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