SiC/SiC COMPOSITES THROUGH TRANSIENT EUTECTIC-PHASE ROUTE FOR FUSION APPLICATIONS—Y. Katoh (Oak Ridge National Laboratory), A. Kohyama, T. Nozawa (Kyoto University), and M. Sato (Ube Industries, Ltd.)

Paper was presented at the 11th International Conference on Fusion Reactor Materials, December 7-12, 2003, Kyoto, Japan, and it will be published in the conference proceedings in the *Journal of Nuclear Material.*

EXTENDED ABSTRACT

Innovative SiC/SiC composites, which possess properties substantially more attractive than conventional SiC/SiC composites, were developed through a processing technique named nano-infiltration and transient eutectic-phase (NITE) process. Representative baseline properties of lab-grade NITE SiC/SiC composite is presented and compared with those suggested for design analysis of SiC/SiC-based power plant for the long term in Table 1. The demonstrated superior strength properties, thermal conductivity, hermeticity, surface smoothness and elevated temperature stability are attributed primarily to the near full-density crystalline SiC matrix. The elevated temperature stability expectedly enables the application of permanent joining and refractory coating techniques which have not been considered for the conventional SiC/SiC composites. Some of those techniques have been demonstrated and others are being studied.

Table 1. Representative properties of NITE SiC/SiC as compared with those suggested for design analysis of SiC/SiC-based power plants for the long term

Key SiC/SiC properties	Suggested value[1]	NITE (lab grade)
Density	~3000 kg/m^3	2800~3000 kg/m^3
Porosity	~5 %	3~6 %
Young's modulus	200~300 GPa	190~220 GPa
Thermal expansion coefficient	4 x 10^{-6} K^{-1}	3.3~4.7 x 10^{-6} K^{-1} (20~1000°C)
Thermal conductivity through thickness	~20 W/m-K	17~29 W/m-K (20°C)* 15~20 W/m-K (1000°C)*
Maximum allowable combined stress	~190 MPa	~150 MPa**
Cost	$\leq$ $400/kg	~$5000/kg***

*Unirradiated

**2/3 of tensile proportional limit stress

***Rough estimate for a 10kg batch of cross-plied composite

Pilot industrial grade materials of NITE SiC/SiC composite were produced in a variety of shapes and sizes. The industrial process is still under development and therefore the material properties for such grade are not yet comparable with those for the lab-grade. However, the pilot grade components have been demonstrating much improved performances over the conventional SiC/SiC composites.

Fundamental and applied research are still being extensively conducted for the purposes of further improvement and tailorability of material properties and reduced cost of industrial material production.