SiC-SiC CMC’s USING BN POWDER COATED SILICON CARBIDE FIBERS

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Silicon carbide composites are desired for use in aerospace, automotive, semiconductor, and high performance materials markets where toughness and graceful failure mechanisms are important. CoorsTek Inc. supplies over one hundred types of engineered ceramic materials, including several compositions of monolithic silicon carbide (SiC). CoorsTek KK, in Japan, has extensive experience processing silicon carbide via several routes, including CVD, reaction bonding, and melt infiltration for commercial production of silicon carbide wafer boats and wafer manipulators. This core competency has been leveraged to accelerate production of silicon carbide matrix composites such as carbon fiber reinforced brakes for performance cars. The most recent evolution of this technology is development of continuous SiC fiber ceramic composites, using the silicon melt infiltration process developed for automotive brakes and semiconductor products.

The improved Tyranno SA woven fabric from Ube was chosen for the reinforcement. A solution dip process was evaluated as the most cost effective approach to coating the SiC fibers with BN powder. By carefully controlling the chemistry of the dip solution, nano-sized BN powder has been successfully coated on the fibers in the woven fabric. Several powders were tested, two solution temperatures, and multiple coating dips were performed. The coated fabric was then dipped in a silicon carbide slurry and dried to produce a prepreg. The fabric was cut into appropriate-sized sections, stacked, and pressed at elevated temperature to form a laminated body. Following a burnout process, silicon infiltration was performed to produce a body with low porosity. 3mm x 4mm x 50mm-long bars were machined for mechanical testing. SEM and optical microscopy were used to observe the fibers, fractured surfaces, and polished cross sections. To evaluate basic mechanical properties, the fracture energy was measured in three point bending tests according to JCRS 201. These results were then used to improve the process, with the goal of producing a low porosity body exceeding 300MPa strength and over 1500 J/m² fracture energy. Results will be presented and an overview of CoorsTek activities in CMCs will be introduced.