Silicon carbide fiber reinforced silicon carbide matrix composites (SiC/SiC) are attractive structural material for high-temperature components as advanced energy system because of their excellent thermo-mechanical and low activation properties. Nevertheless, there are some critical issues connected to the size and complex shapes of the component for practical use because of machining difficulties. The solution to this problem is to use joining to build up large or complex shapes from a series of smaller and simply shaped components. Joining of SiC/SiC has been demonstrated using various techniques including diffusion bonding, brazing bonding and hot pressing with sinterable SiC powder. Development of reliable and simple joining method for SiC/SiC composites that satisfies the requirements of mechanical integrity, thermal properties and safety during operation and maintenance or accident is strongly required.

In this study, joining methods with SiC powder as the joining adhesives were studied in order to avoid the residual stresses coming from CTE (Coefficient of Thermal Expansion) mismatch between substrate and joining layer. The mechanical strength and microstructure of joining material between SiC substrates are investigated. It has been also examined to produce SiC component with channel by using joining technique like powder sintering and diffusion bonding. The commercial Hexoloy-SA (Saint-Gobain Ceramics, USA) used in this work as substrate material. The fine β-SiC nano-powder which the average particle size is below 30 nm, Al₂O₃, Y₂O₃, and SiO₂ were used as joining adhesives. The specimens were joined with 20MPa and 1400-1900°C by hot pressing in argon atmosphere. The tensile and shear tests were performed to investigate the bonding strength. The cross-section of the joint was characterized by using an optical microscope and scanning electron microscopy (SEM). The joining conditions for SiC component with channel were optimized at 1800°C and 20MPa. In sintering powder method, SiC component with channel were successfully produced. However, the part of notch caused high stress concentration was observed in joining layer. In order to solve this problem, diffusion bonding method was performed on the SiC component with channel.