FABRICATION OF $SiC_f/SiC–ZrB_2$ COMPOSITES BY A HYBRID PROCESS OF ALTERNATING CURRENT ELECTROPHORETIC DEPOSTION (AC-EPD) AND HOT PRESSING

Kati Raju, Energy Materials Research Division, Korea Institute of Energy Research, South Korea
katiraju@gmail.com
Wahid Muhamad, School of Materials Science and Engineering, Yeungnam University, South Korea
Seyoung Kim, Energy Materials Research Division, Korea Institute of Energy Research, South Korea
Dang-Hyok Yoon, School of Materials Science and Engineering, Yeungnam University, South Korea

Key Words: $SiC–ZrB_2$ composites, Electrophoretic deposition, Hot press.

In this study, we report on the fabrication of continuous SiC fiber-reinforced $SiC–ZrB_2$ ceramic matrix composites ($SiC_f/SiC–ZrB_2$) through a hybrid process of slurry impregnation by electrophoretic deposition and hot pressing. An effective impregnation of the slurry into the fine voids of fiber preform is essential to fabricate dense composites, which was achieved by a simple, fast and efficient electrophoretic deposition method. With increased interest in ultra-high temperature ceramics (UHTCs), there has been a significant effort on the development of $SiC–ZrB_2$ composites. Numerous efforts have been also made on the incorporating of fiber reinforcement phase into these UHTCs to enhance overall mechanical properties in recent years. In this regard, $SiC_f/SiC–ZrB_2$ composites were fabricated by infiltrating a $SiC–ZrB_2$ matrix phase containing Sc_2O_3 sintering aid into the Tyranno^{TM}-SA grade-3 fabrics coated with pyrolytic carbon and SiC interphase layers using an AC electrophoretic deposition (AC-EPD) combined with ultrasonication. AC-EPD was performed using a dual electrode system under an applied voltage of 20 V for 30 min. The zeta potential of the slurry was set to ≥ +40 mV at pH = 10 to achieve uniform infiltration of constituent particles into the preform. After infiltrating water-based slurry into the fine voids of fabrics by AC-EPD, 15 layers of fabrics were stacked and laminated. Hot pressing was carried out at 1750^{o}C in an Ar atmosphere after binder burnout. The composite densities, microstructures and mechanical properties as a function of the various processing parameters along with the effectiveness of AC-EPD will be discussed in detail.