Influence of the carbonization temperature on the mechanical properties of thermoplastic polymer derived C/C-SiC composites

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ABSTRACT

Carbon/Carbon (C/C) composites derived from the thermoplastic polymer polyetherimide (PEI) were pyrolyzed up to 1000 °C, subsequently carbonized in inert atmosphere up to 2200 °C and afterwards infiltrated with liquid silicon. The investigation of fibers and matrix with Raman microspectroscopy revealed, that an increased carbonization temperature leads to an increased carbon order as well as an incipient stress-induced graphitization of the carbon matrix close to the fiber surfaces at 2200 °C. The derived C/C-SiC samples show a maximum flexural strength of 180 MPa with C/C composites treated at 2000 °C and monotonically increasing Young's moduli ranging from 49 GPa with C/C preforms treated at 1600 °C up to 59 GPa after carbonization at 2200 °C. The carbon fiber strength was evaluated with a single fiber tensile test, which showed a monotonically increased Young's modulus and a decrease of the strength after carbonization at 2200 °C.