SILICON NITRIDE FIBER REINFORCED SIC MATRIX COMPOSITES

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ABSTRACT: Silicon nitride fiber reinforced SiC matrix composite has been prepared and the micro-mechanical properties of the composites *in situ* have been explored. For the Si3N4 fibers, the micro-mechanical properties *in situ* are unchanged with the increasing fabrication temperatures. The interfacial shear strength of the composite was significantly increased from 400 MPa to 520 MPa with the fabrication temperature increasing from 800 °C to 1200 °C, thus impeding the toughening mechanisms of the composites.

FABRICATION: A Silicon nitride fiber preform was chosen as reinforcements of the Si_3N_4f/SiC composites. The Si_3N_4f/SiC composite was fabricated by conventional precursor infiltration and pyrolysis (PIP) process, using polycarbosilane (PCS) as matrix precursor.

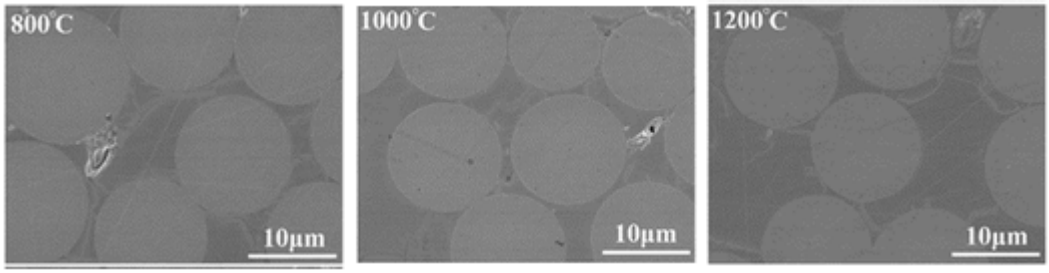

Figure 1: Cross-sectional images of Si_3N_4f/SiC composites fabricated at different temperatures.

CHARACTERIZATION: The phase composition of the composites was investigated by XRD analysis, as shown in figure 2. The Si_3N_4 fiber remains amorphous until the temperature was increased up to 1200 °C. With the rise of temperature, the main diffraction peaks at 36° and 60° respectively corresponding to (111) and (220) planes of β-SiC became increasingly apparent.

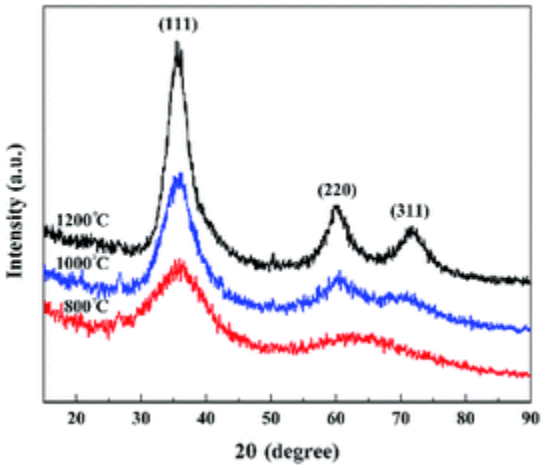

Figure 2: XRD patterns of Si_3N_4f/SiC composites fabricated at different temperatures.

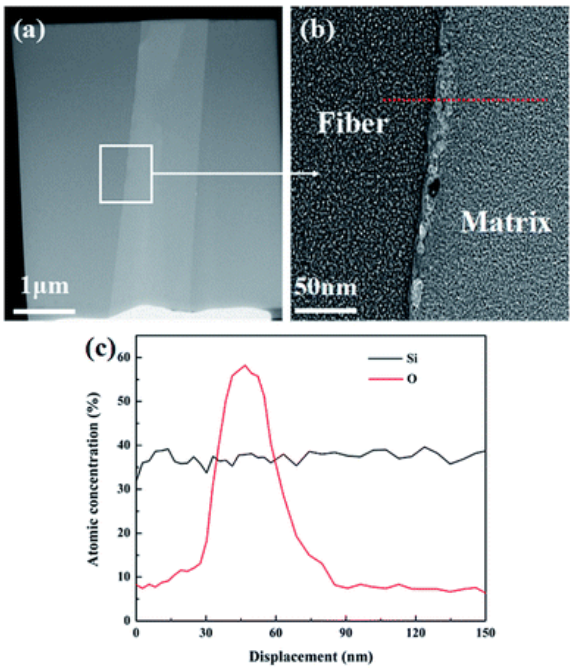

Figure 4: (a and b) Interfacial zone analysis of the Si_3N_4f/SiC-800 °C composite; (c) EDS analysis of the red dashed line in (b).

The cross-sectional TEM images of interfacial zones in the Si_3N_4f/SiC-800 °C composite were shown in figure 4. As expected, the Si3N4 fiber was amorphous.

CONCLUSION: On account of stable microstructure, the Si_3N_4 fiber showed a stable Young' modulus (170 GPa), hardness (18 GPa) and fracture toughness (3 MPa m1/2), indicating an excellent thermal–mechanical property of the Si_3N_4 fiber that was barely degraded after high temperature composite fabrication process..

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