Microstructure and Properties of in situ Transformed carbon fibre toughed Alumina Composite

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A novel process for ceramic matrix composite preparation was proposed. Hereby, pre-oxidized polyacrylonitrile (PAN) fibers as a precursor of carbon fibers, and the PAN fibers would be in situ transformed into carbon fibers and homogeneously distributed in the alumina matrix by controlled sintering process. The novel process made that carbon fiber formation and composite preparation were synchronously completed. It reduces not only the damage of carbon fibers, but also simplifies the composite preparation process and improves interface bonding. The phase structure of the in situ transformed carbon fibers, the interface and the microstructure of the composite were analyzed by XRD, SEM and TEM. The nanoindentation, hardness, friction and wear properties were measured and anlyzed. The results show that twice grade heating separately at 444°C and 1070°C for 10min and a sintering temperature of 1700 °C process ensures the formation of in situ carbon fibers. XRD analysis shows that the composite presents a typical diffraction peak at 26.3°, which corresponds to the (002) crystal face of carbon fibers, and the iriterlayer spacing d_{002}=0.3425nm. TEM shows that the carbon atoms array in the form of turbostratic graphite platelet along the axile direction of carbon fibers, the peel and core structure of the carbon fibre is different. The carbon content of the in situ transformed carbon fibers is 92.68%. The friction coefficient decreases with time both under dry and water lubrication. The in-situ Cf/Al_2O_3 composite presents a self-lubricated property and excellent wear resistance.

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