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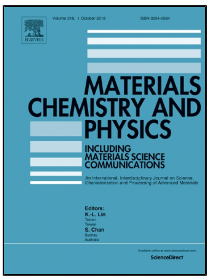

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Improvements in mechanical properties of SPS processed 15R-SiAlON polytype through structurally survived MWCNT reinforcement

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Abstract: Present work reports the effects of multiwalled carbon nanotube (MWCNT) reinforcement on sintering and mechanical properties of additive free, dense (>96%) 15R-SiAlON polytype. Laboratory made precursor polytype powder, prepared through carbothermal-reduction-nitridation technique and devoid of any external sintering additive, were dispersed with MWCNT and were consolidated using spark plasma sintering at 2000°C for 10 minutes under 40 MPa. Differential electrical conductivity causing localized heating resulted in improved sintering behaviour in the composites. Apart from formation of both equiaxed and elongated SiAlON grains, various CNT/SiAlON interactions were noticed in the composites. Depending on test load, the 0.5 wt.% MWCNT/15R-SiAlON composite offered 9.6–17% and 12–13% higher hardness and indentation fracture toughness, respectively, over the monolith. Indentation size effect and load dependence of indentation toughness of the studied specimens have been reported. Under 20N, >30% reduction in specific wear rate was observed at only 0.5 wt.% MWCNT loading. Self-reinforcement offered by elongated matrix grains, reinforcement by structurally survived CNTs, matrix grain refinement by the dispersed nanotubes and solid lubrication offered by the pulled-out CNTs were the key factors behind obtaining improved tribo-mechanical performance of the composites over pure 15R-SiAlON polytype.

Key words: SiAlON polytype; Carbon nanotube, Spark Plasma Sintering, Microstructure, Tribo-mechanical properties

1. Introduction

Owing to the attractive properties of SiAlON ceramic, this group of materials has gained immense interest towards successful utilization for various high performance applications. Depending on the particular phase of the Si-Al-O-N system, its strength can be in the order of 850 MPa or even higher, modulus can be 230–316 GPa, Vickers hardness (HV) can vary

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