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Ceramic carbides materials such as SiC, due to their refractory nature and their low neutron absorption are believed to be promising candidates for high temperature nuclear or aerospace applications.

However, SiC brittleness has limited its structural application. In order to overcome this drawback, a reduction of grain size below 100 nm is expected to enhance mechanical properties. On the other hand, the grain downsizing should result in a strong decrease of the thermal conductivity because of the enhanced phonon scattering at the grain boundaries. In order to counteract this effect, multiwall carbon nanotubes (MWCNTs) could be of great interest because of their interesting thermal properties. Moreover, MWCNTs show a strong toughness which should also help to enhance the mechanical properties as reviewed by several authors. We report here the study of the elaboration of such nanoSiC / MWCNTs composites using gas-phase synthesized nano-objects together with the related thermal, electric and mechanical properties.

For this study, the starting nanoscale building blocks (nanoparticles and nanotubes) were synthesized by gas phases processes. β-SiC nanopowders with a mean particle smaller than 20 nm were obtained by a laser assisted CVD flow process, namely laser pyrolysis, using a CO_2 laser to decompose the gaseous precursors (silane and acetylene). MWCNTs several hundred microns in

length were grown as carpets on substrates by continuous catalytic CVD using an aerosol of toluene and ferrocene used as carbon and catalytic iron precursors, respectively. Dispersion of SiC nanopowders was obtained in an aqueous medium under magnetic stirring with dedicated dispersing agent. Several samples were prepared, differing in surface composition (C or Si excess) and sintering additives content (from 0 to few wt%). MWCNTs were dispersed by means of an ultrasonic probe and subsequently mixed with SiC slurries with different concentrations. Green bodies were then prepared by slip-casting. In order to avoid grain growth while keeping satisfying densification, spark plasma sintering (SPS) was used for this study. Thanks to this fast sintering process, SiC matrix grain size was kept under 100 nm while final densities were higher than 96%. Finally, samples with different chemical (Si, O, C) compositions and MWCNTs contents were subjected to mechanical characterization (hardness, toughness), resistivity, and thermal conductivity measurements with the aim of correlating the final microstructures to the mechanical, electric and thermal behavior.

Keywords: Silicon carbide, Carbon nanotubes, Ceramic Matrix Composites, Nanomaterials