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## Carbon Nanotube/Titanium Carbide Sol-gel Coated Zirconium Diboride Composites

### Prepared by Spark Plasma Sintering

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### Abstract

With combination of a powder processing technique and a sol-gel process, carbon nanotube/titanium carbide coated zirconium diboride matrix composite was fabricated. Zirconium diboride ( $ZrB_2$ ) powders were coated with a functionalized carbon nanotubes (CNTs) mixed titanium carbide (TiC) sol-gel precursor. As the results suggests, the carbothermal reduction produced nanosized TiC grains at the surface of the  $ZrB_2$  particles with a homogenous distribution of CNTs. The densification of the CNT/TiC coated  $ZrB_2$  matrix composite was achieved via 1900 °C spark plasma sintering (SPS). The TiC grains and the CNTs were primarily concentrated in the grain boundaries of the  $ZrB_2$  and showed the pinning effects that restrained the growth of  $ZrB_2$  grain. The TiC grain diffusion in the sintering coarsened the grains from nanosizes to 1-2  $\mu m$ , which improved the densification of the  $ZrB_2$ . Due to the difference in coefficient of thermal expansion, CNTs bridged the gaps between the TiC and the  $ZrB_2$  matrix, which formed a weak-bonding interface. The major toughening mechanism found was crack deflection via the TiC grains on the  $ZrB_2$  matrix.

*Keywords:* Carbon nanotube, Sol-gel, SPS, Titanium carbide,  $ZrB_2$

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