Intragranular reinforcement of alumina-based composites with carbon nanotubes via sol-gel

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The reinforcement of the ceramic matrix composites has been widely studied by the inclusion of carbon nanotubes (CNT) [1]. Nevertheless, the efficiency of this reinforcement when the CNT are located in the grain boundaries is still under debate. In this work, the synthesis of the composites has been designed with the aim of achieving an intragranular presence of the CNT in order to reach a more efficient reinforcement.

Different routes based on the sol-gel method were tested to prepare alumina based composites with CNT [2,3]. The CNT were mixed by the addition of a basic suspension of CNT upon high power ultrasounds. The pH and ultrasounds enhanced the good dispersion and disentanglement of the CNT, but they also contributed to the rapid and controlled gelation of the samples. Finally, alumina composite powders were submitted to Spark Plasma Sintering. First CNT contents covered a range from 0.00 to 1.00 wt.%.

The obtained alumina gels showed good homogeneity at optical level, and no coils or agglomerates of CNT were observed by electron microscopy (SEM). In addition, images showed the presence of the CNT within the core of the particles of the gel (Fig. 1).

Mechanical properties were assessed by indentation techniques. First results (Fig. 2) showed relevant reinforcements, such as a two-fold increase in Vickers hardness (HV) with the addition of 0.50 wt.% of CNT. These findings confirm the sol-gel route as a promising strategy for fabricating ceramic reinforced with carbon nanotubes.

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References

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Figures

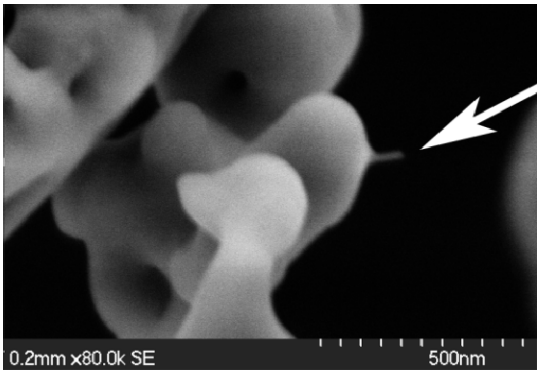

Figure 1: SEM picture showing one CNT (arrow) within alumina particle, prior to sintering

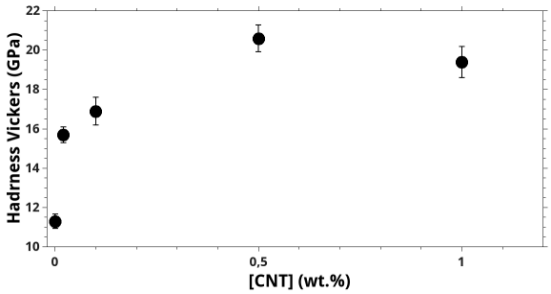

Figure 2: HV with 10 kp load for alumina samples with 0.00, 0.05, 0.10, 0.50 and 1.00 wt.% of CNT