

# High temperature mechanical spectroscopy study of 3 mol% yttria stabilized tetragonal zirconia reinforced with carbon nanotubes

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Composites made of 3 mol% yttria stabilized tetragonal zirconia (3Y-TZP) reinforced with multiwalled carbon nanotubes (CNTs) were processed by spark plasma sintering with various amounts of CNTs (3Y-TZP / X wt% CNT, X= 0, 0.5, 1.5, 3 and 5). Microscopic analysis proves that CNTs are well dispersed and embedded in grain boundaries of the sintered body. High temperature mechanical properties were investigated using mechanical spectroscopy and low stress (8MPa) creep. Figure 1 shows the isothermal spectrum of pure and CNT-reinforced 3Y-TZP measured as a function of frequency. The general spectrum consists of a mechanical loss peak at a frequency of about 0.1 Hz, which is superimposed on an exponential increase at low frequency. The absence of a well-marked peak in monolithic 3Y-TZP is justified considering that the restoring force due to the elasticity of neighboring grains decreases at low frequencies or high temperatures. Therefore, strain is not anymore limited and the mechanical loss increases exponentially, which is correlated to macroscopic creep. However, with CNT additions the mechanical loss decreases and a better resolved peak was observed (Fig. 1). In parallel, the results have shown that the creep rate drastically decreases with CNT additions. These results can be interpreted by the pinning effect of CNTs, which can hinder grain boundary sliding at high temperatures, resulting in a creep resistance improvement. A rheological analysis shows that CNTs provide a restoring force inhibiting sliding of grains. Therefore, the effect of grain boundary sliding on creep and on mechanical loss is shifted to higher temperature or lower frequency.

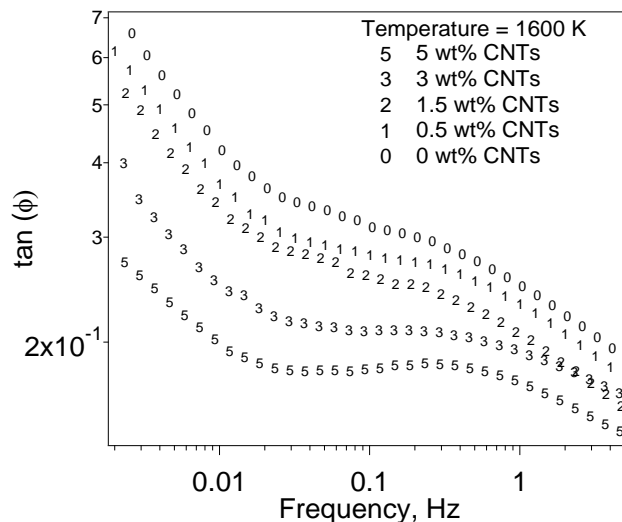


Fig. 1. Isothermal mechanical loss of pure 3Y-TZP and 3Y-TZP reinforced with CNTs as a function of frequency.

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