

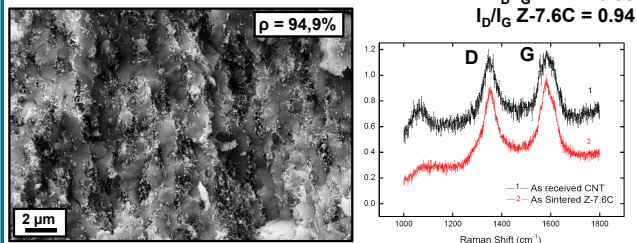
Processing of Ceramic Composites by Field-Assisted Sintering Technology/Spark Plasma Sintering

J. Gonzalez-Julian¹, O. Guillon^{1, 2}

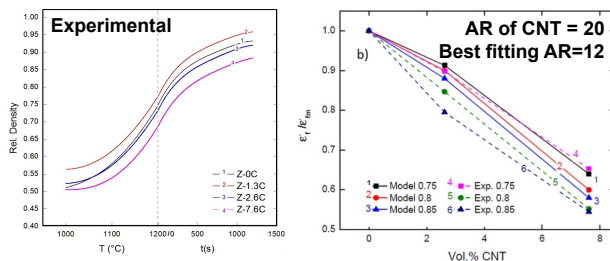
¹ Forschungszentrum Jülich GmbH, Jülich, Germany
Institute of Energy and Climate Research, IEK-1: Materials Synthesis and Processing
² JARA Energy, Aachen/Jülich, Germany

Field-Assisted Sintering Technology/Spark Plasma Sintering (FAST/SPS) enables to fully densify Ceramic Matrix Composites (CMCs) due to the combination of high pressure and short sintering cycle and exposure time to high temperature, avoiding reaction and/or transformation into new phases. Analysis of the sintering behaviour of fully yttria-stabilized zirconia mixed with different contents of carbon nanotubes (8YSZ/CNT), surface treatment and oxidation tests on FAST/SPSed zirconium diboride containing 20 vol.% of silicon carbide particles (ZrB_2/SiC) and processing of new and advanced materials based on MAX phases were investigated.

8YSZ/CNT



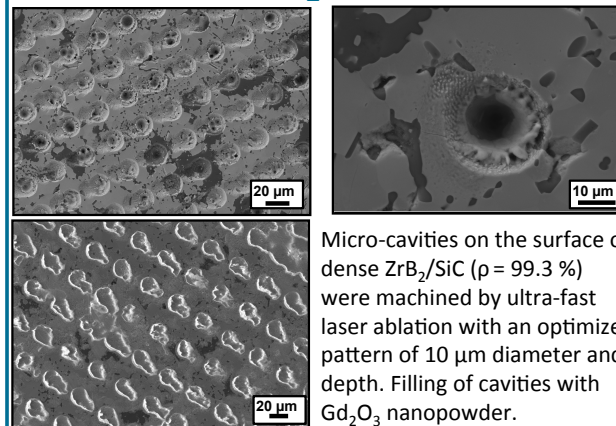
Highly dense composites containing up to 7.6 vol.% of multi-walled carbon nanotubes. No degradation of the CNT was confirmed by Raman spectroscopy.



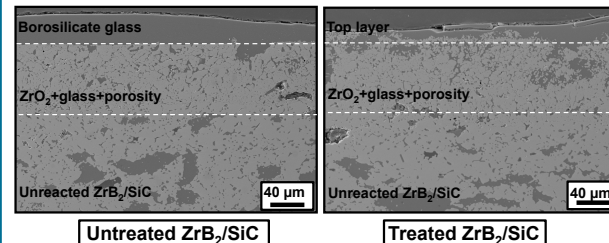
Better packing and densification for low amounts of CNTs; for larger amounts, continuum mechanical model of constrained sintering (rigid elongated inclusions). Flexibility of CNT reduced the stress, decreasing the effective aspect ratio from 20 to 12.

A.M. Zahedi, J. Gonzalez-Julian, M. Mazaheri, J. Javadvpour, H. R. Rezaie, O. Guillon, J. Eur. Ceram. Soc., 35 (2015), 4241-4249

ZrB_2/SiC



Oxidation: 1600 °C for 1 h in static air

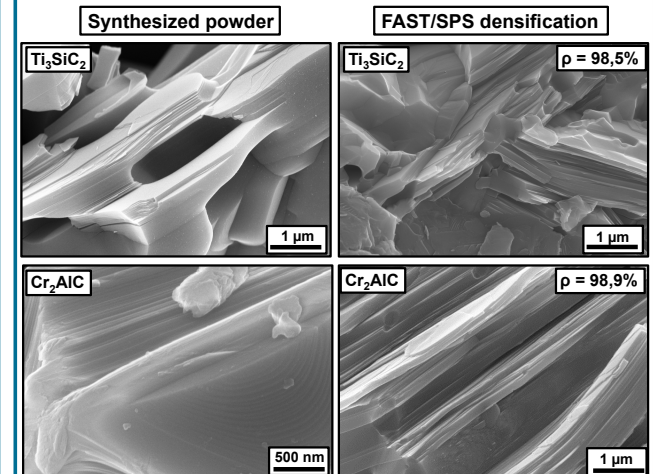


Gadolinium was incorporated during the thermal process into the borosilicate glass, entailing glasses of higher viscosities with lower oxygen diffusivities. The thickness of the protective liquid layer was reduced by 60 %.

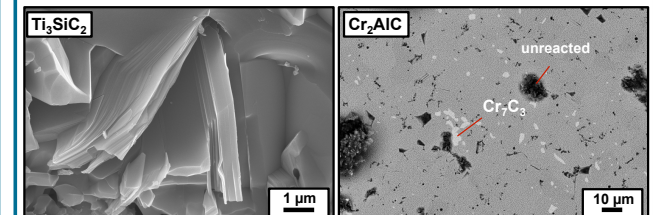
J. Gonzalez-Julian, O. Cedillos, S. Döring, S. Nolte, O. Guillon, W. E. Lee, J. Eur. Ceram. Soc., 34 (2014), 4157-4166

MAX phases

Synthesis and FAST/SPS sintering of Ti_3SiC_2 or Cr_2AlC were carried out in two different steps:



Or simultaneously in one step by FAST/SPS (reactive sintering):



Fast heating rate and short dwell time limited the reaction kinetics to form the pure MAX phases.

J. Gonzalez-Julian, S. Onrubia, M. Bram, O. Guillon, J. Eur. Ceram. Japan, 124 (2016). DOI: 10.2109/jcersj2.124.P4-1