FLASH SPARK PLASMA SINTERING OF UHTCS

Salvatore Grasso, School of Engineering and Material Science, Queen Mary University of London, UK
s.grasso@qmul.ac.uk
Theo Saunders, Elinor Grace Castle, Peter Tatarko, Mike Reece, School of Engineering and Material Science, Queen Mary University of London, UK
Jon Binner, Ji Zou, School of Metallurgy and Materials University of Birmingham, UK
Omar Cedillos-Barraza, Eugenio Zapata-Solvas, Samuel Humphry-Baker, William E. Lee, Centre for Advanced Structural Ceramics, Department of Materials, Imperial College London, UK
Andrew Duff, Thomas Mellan, Michael W. Finnis, Department of Materials, Thomas Young Centre, Imperial College, London, UK
Martin Fides, Richard Sedlák, Tamás Csanádi, Vladimir Girman, Pavol Hvizdos, Ján Dusza, Institute of Materials Research, Slovak Academy of Sciences, Košice, Slovakia

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During the five year XMat research project supported by EPSRC (Engineering and Physical Sciences Research Council, UK) at Queen Mary we developed a novel sintering technique called Flash Spark Plasma Sintering (FSPS[1]) which is particularly suitable for the ultrarapid (a few seconds) consolidation of UHTCs. As in the case of incandescent lamps, flash sintering techniques use localized Joule heating developed within the consolidating particles using typically a die-less configuration. Heating rates are extreme (10^4–10^6 °C/min), and the sintering temperature is therefore reached extremely rapidly. The research covered mostly metallic conductors (ZrB_2[2], HfB_2,TiB_2) and semiconductors (B_4C, SiC and their composites). The talk will summarize the joint XMat team efforts to:

-Identify the FSPS consolidation mechanism using modelling and transmission electron microscopy,

-Characterise the structural properties for the bulk materials and redefine the structure-property relationships of FSPSed materials

- Use FSPS processing to achieve unique materials by developing metastable phases and controlling point (vacancy and interstitials), linear (dislocations), planar (grain boundaries) and volume (secondary phases) defects.

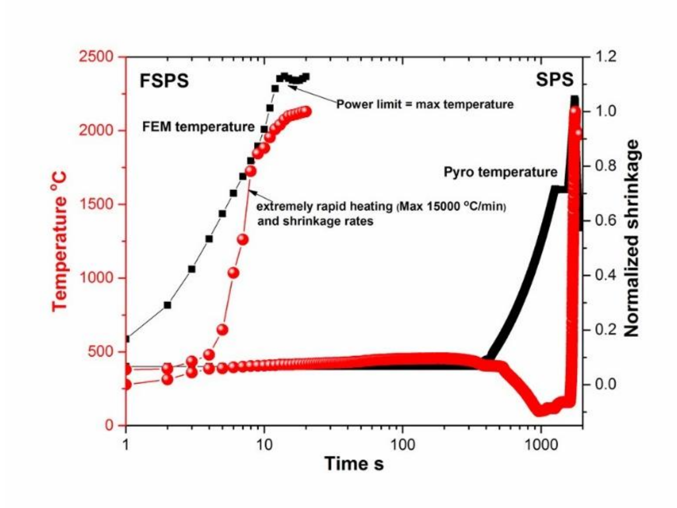

Figure 1 –Comparison of normalized displacement and temperature for SiC sample (as a function of time for Flash and Conventional SPS

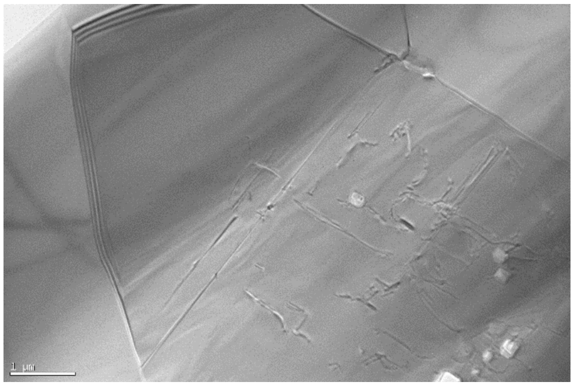

Figure 2 – TEM images of flash sintered boron carbide highlighting dislocations in the bulk of a grain.

References

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2 Grasso, S. et al. Flash spark plasma sintering (FSPS) of pure ZrB_2. J. Am. Ceram. Soc. 97, 2405-2408 (2014).