

2<sup>nd</sup> International Conference and Expo on

# Ceramics & Composite Materials

July 25-26, 2016 Berlin, Germany

## Processing of metal-ceramic composites using microwave heating

Dinesh Agrawal<sup>1</sup>, Jiping Cheng<sup>1</sup>, P G Karandikar<sup>2</sup> and M K Aghajanian<sup>2</sup><sup>1</sup>Pennsylvania State University, USA<sup>2</sup>M Cubed Technologies Inc., USA

Microwave technology is an emerging field in materials processing for synthesis, sintering, melting, joining, surface-modifications, recycling of waste products, quality improvements, etc. Microwave processing of materials is highly attractive and recognized for its many advantages namely energy-efficiency, substantial reduction in process cycle time, providing fine microstructures leading to improved mechanical properties and eco-friendliness. This presentation describes microwave application to fabricate metal-ceramic composites by molten metal infiltration and reaction bonding in-situ process. Metal Ceramic Composites (MCC) offers tailorable physical, thermal and mechanical properties for a variety of applications. Conventional fabrication of the composites using molten metal infiltration mechanism involves use of the resistance heated furnaces and takes very long processing cycle time. This work relates the ability of microwave to enhance the infiltration and reaction processes to fabricate composites. Identical composite compositions were also fabricated using conventional heating for comparison. Properties of the composites made by microwave heating were comparable or better than the properties of the composites made by the conventional methods. Substantial process time reductions were achieved for all the infiltration processes using microwave. Several prototype components for real applications were fabricated to demonstrate process scale up.

[dx44@psu.edu](mailto:dx44@psu.edu)

## Energy-efficient sintering of ceramics

Eugenio Zapata-Solvas

Imperial College London, UK

Electric current assisted sintering (ECAS) techniques, such as electrical discharge sintering (EDS) or resistive sintering (RS), have been intensively investigated for longer than 50 years. In this work, a novel system including an electrically isolated graphite die for Spark Plasma Sintering (SPS) is described, which allows the sintering of any refractory ceramic material in less than 1 minute starting from room temperature with heating rates higher than 2000°C/min and an energy consumption up to 100 times lower than with SPS. The system alternates or combines direct resistive sintering (DRS) and indirect resistive sintering (IRS). Electrical isolation of the die has been achieved through the insertion of a film made of alumina fibers between the graphite die and the graphite punches, which are protected from the alumina fibers film by a graphite foil. This system localized the electric current directly through the sample (conductive materials) as in DRS and EDS, or through the thin graphite foil (non-conductive materials) as in IRS or RS and is the first system capable of being used under EDS or RS conditions independently, combining current concentration/localization phenomena. In addition, geometry elements of the graphite mold used for SPS, such as graphite mold wall thickness or graphite punch diameter, play an important role in the electric field magnitude during sintering. Furthermore, electric field for this novel geometry will be analyzed as well as tailorability of electric field in order to intensify the value of the electric field towards induced flash sintering in a SPS furnace.

[eugenio.zapata-solvas@imperial.ac.uk](mailto:eugenio.zapata-solvas@imperial.ac.uk)