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ESTIMATING IONIC CONDUCTIVITY DURING FLASH SINTERING OF 8YSZ

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Key Words: flash sintering, sintering, YSZ, zirconia, current-assisted, FAST,

We provide evidence for temperature-driven flash sintering process, accounting for otherwise interpreted as abnormal behavior. Using 8%-Yttria-doped Zirconia as reference material, we selected moderate flash conditions

to avoid external current-limiting control. Samples were dry-pressed and pre-sintered to relative densities between 50 and 85 %TD by interrupting sintering at predetermined shrinkage values, in conventional and flash sintering processes. SEM characterization shows similar trends for average grain size, porosity levels and distribution between flash and conventional samples. Bulk and grain boundary conductivity and characteristic frequencies, measured by impedance spectroscopy, show similar behavior regardless of the processing route.

A third series of samples were pre-sintered and then flash sintered. The conductivity was measured as a function of relative density for different temperatures. These data were used to derive a scaling-law for flash sintering, which expresses sample conductivity versus temperature, corrected for instantaneous density. It replicates the signature current runaway during flash sintering which has been associated with unconventional sintering mechanisms.

We conclude instead that it derives simply from the interdependence of conductivity with densification and sample self-heating through joule effect. A rough estimate of sample temperature can convert this non-linearity to a well-known Arrhenius behavior. Results apply equally well to previously published data, both in isothermal or constant heating conditions.

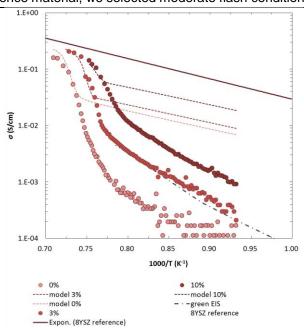


Figure 1 – Figure 2 – Experimental (circles) and estimated (dashed lines) sample conductivity, σ, during flash sintering versus furnace temperature.