COMPARISON OF THE ELECTRICAL AND STRUCTURAL CHARACTERISTICS OF FLASH SINTERED YTTRIA-STABILIZED ZIRCONIA

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One of the primary conundrums in the study of field-assisted sintering techniques is distinguishing between the effects of Joule heating and the athermal electric field on both the sintering process and properties of the sintered material. This is particularly true in the case of flash sintering, in which accurate and spatially differentiated temperature measurement is difficult, complicating the removal of baseline Joule heating. While high heating rates have been linked to rapid consolidation in the absence of an electric field[1], the field is assumed to affect defect behavior during sintering and produce effects on the resulting microstructural and electrical characteristics[2,3]. Studying these residual properties and their relationship to flash sintering processing parameters lends insight into the degree and nature of the field contribution during flash sintering.

We present a study using impedance spectroscopy and microstructural analysis to characterize flash sintered 8 mol % yttria-stabilized zirconia (YSZ). Samples were produced using a controllable AC flash system and parameters including frequency, current ramp rate, and electrode composition were varied. Results are contextualized within the growing understanding of the thermal characteristics of flash[4-6] as well as the effect of electric fields on cation[7] and grain boundary mobility[8] to understand the implications of observations like enhanced bulk conductivity, sensitivity of grain boundary conductivity to various processing parameters, and the temporal development of grain size. This work provides a useful perspective to the flash sintering literature with combined analysis of electrical properties and microstructure. Moreover, flash sintering via a combination of AC fields with controlled current ramps is demonstrated to be an effective route to producing more homogeneously sintered materials.

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