INFLUENCE OF 3YSZ SAMPLE HEIGHT AT THE ONSET OF FLASH SINTERING

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Flash sintering has drawn attention at the science community because of its capable of densifying materials in few seconds, with low energy consumption, and low furnace temperatures [1]. In spite of these advantages, there are still some difficulties to apply flash sintering at an industry level. These difficulties are mainly regarded about the dimensions of the material which would be sintered. Bigger ceramic bodies have a tendency to form hotspots that decrease its mechanical properties. In this work, we study the influence of the height of 3YSZ cylindrical samples at the onset temperature of flash sintering. It was observed that samples with greater height have a tendency to start densifying earlier than the one with lower height; it means that the onset of flash sintering for bigger samples happens sooner than smaller ones, Figure 1. Illustrate that behavior. This phenomenon can be attributed at a voltage drop at the resistance at the contact between electrode and sample, since the voltage drop is equal for samples with same diameter, but the voltage applied is lower for samples with smaller height (in order to keep the same electric field). The experimental procedure was taken for five different sample height (2, 4, 6, 8 and 10 mm) of a cylindrical shape with 6 mm diameter. All the samples were flash sintered at a tubular furnace setup proposed before [2]. We used 90 V/cm as maximum electric field at AC mode (sinusoidal waveform with 1000 Hz frequency), and 100 mA/mm² as maximum current density for all the different samples height (the voltage and current values were expressed in RMS basis). No conductive paste (such as Pt paste) was used between the electrodes and the samples. The bulk density of the samples was measured by the Archimedes method and a strong correlation between the sample height and the bulk density was observed. Higher samples presented a lower density, it could be explained for two subjects: (1) because of the onset temperature differences that could lead to a minor maximum temperature during the flash event when compared with the lower samples; and (2) higher samples have more open surface area which allows more energy lost at radiation process. The Pt conductive paste is usually expensive and the dependency of conductive paste to minimize this electrode/sample electric resistance is a challenge that must be overcome for flash sintering be applied at industry level.