MULTI-PHASE FLASH SINTERING: THE NEXT NATURAL STEP IN FLASH SINTERING EVOLUTION

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In this work, a Multi-Phase Flash Sintering (MPFS) configuration is proposed to enhance Flash Sintering (FS) of ceramic materials, which typically makes use of single-phase electric power (either DC or AC). Since the usual FS experimental setup is limited to two electrodes, the uni- or bi-directional current flow habitually results in localization and preferential current path issues [1]. Moreover, the specimen shape is restricted to basic geometries such as cylinders, *dog-bones*, rods or plates [2]. Three or more electrodes are equidistantly placed over the edges of the sample and connected to a multi-phase power supply, creating a rotating electric field across the entire sample. The more uniform electric field distribution in MPFS results in higher delivered power for a given voltage at a certain temperature (Figure 1a). This way, the flash-onset can be triggered not only at lower temperatures but also using lower applied voltages, thus mitigating undesired localization phenomena and promoting thermal uniformity. It is shown that 3D complex-shaped specimens of materials with different types of electrical conduction mechanisms (ZnO and 8-mol% Yttria-Stabilized ZrO_2) can be homogeneously sintered in a matter of seconds at furnace temperatures lower than those used in conventional FS under the same voltage. For example, 8YSZ can be flash-sintered under voltages as low as 20 V using the MPFS technique, but the flash cannot be activated below 30 V in a conventional DC-FS configuration (Figure 1b). All in all, MPFS can be considered an interesting methodology for the industrial implementation of FS due to its effectiveness and smaller energy footmark in comparison to traditional sintering techniques and even to conventional FS.

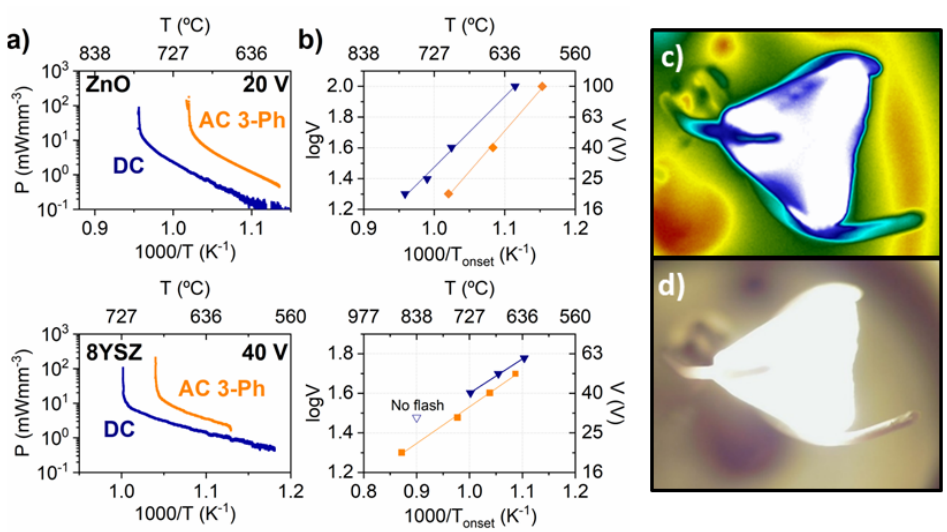

Figure 1: (a) Power density profiles, (b) applied voltage vs flash-onset temperature for ZnO and 8YSZ using DC-FS and MPFS, (c) thermographic and (d) optical images during MPFS on an 8YSZ triangle-shaped specimen

References

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