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Hybrid Microwave Sintering of Yttria Stabilized Zirconia

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Hybrid microwave (HMW) processing was used to investigate the sintering behavior of 8 wt.% yttria-stabilized zirconia (YSZ) ceramic material. HMW sintering offers several advantages over conventional sintering methods such as but not limited to lower sintering temperatures, shorter times, selective and uniform heating as well as improved materials properties. 8 wt.% YSZ is a ceramic material and has the fluorite structure as uranium dioxide (UO_2). Commercial 8% YSZ powder was used in the current study where it was pressed and molded into green body disks using uniaxial press before it was sintered using HMW heating using 2.45 GHz microwave frequency combined with conventional heating at the same cavity. Similar YSZ green disks were sintered at 3 different temperatures: 1350oC, 1400oC and 1450oC using the same holding time of 2 hours before cooling down to room temperature. The HMW sintered disks were then characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM) and density measurement using Archimedes method. The crystal size of HMW sintered samples was calculated to be around 49-51 nm using Scherrer method at (111) plane at the sintered temperatures. Furthermore, SEM micrographs of the HMW sintered samples showed the typical sintering pattern of YSZ with its well-defined formed grains and grain boundaries. The samples with higher HMW sintering temperature exhibited the highest achieved densities values. HMW processing was used successfully to sinter 8 wt.% YSZ samples in a much lower temperature and shorter time compared to conventional sintering as inferred from the indexed XRD patterns and SEM micrographs of the sintered samples. Hybrid microwave processing is considered as a promising technique to sinter YSZ materials.

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