FIELD-INDUCED MASS TRANSPORT PHENOMENA IN FLASH SINTERED HIGH TEMPERATURE CERAMICS EXPLORED BY IN SITU SEM AND TEM

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Flash sintering has attracted significant attention lately as its remarkable rapid densification process at low sintering temperature leads to the retention of fine grains and enhanced dielectric properties. However, the underlying mechanism of flash sintering and mechanical behaviors of flash-sintered ceramics remain poorly understood. Here, we report the microstructure of flash-sintered yttria-stabilized zirconia (YSZ) and TiO2 by transmission electron microscope (TEM) and their high temperature in-situ micropillar compression studies inside a scanning electron microscope (SEM). Our studies on flash-sintered YSZ show that YSZ exhibits high inelastic strain (~ 8%) primarily due to phase transformation toughening below 400°C. At higher temperatures, crack nucleation and propagation are significantly retarded and prominent plasticity arises mainly from dislocation activities. The holding time and current density limit after the onset of flash for flash-sintered TiO2 significantly affect the microstructure and mechanical behavior. High dislocation density and stacking faults have been observed in the flash-sintered TiO2 under TEM. The presence of high-density defects generated during flash sintering plays a major role in the overall microstructure and mechanical behavior of ceramics.