HIGH TEMPERATURE TENSILE BEHAVIOR OF ZIRCONIA CERAMICS UNDER DC CURRENT

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These Flash sintering phenomena, which occurs by applying DC current directly to ceramic powder compacts, has been the subject of many paper of ceramic sintering. This is because the flash event can succeed to lower the sintering temperature/time of several ceramic powders. On the other hand, Conrad and his colleagues examined the effect of electric fields on the high temperature tensile properties of 3Y-TZP and confirmed that the fields can lower the tensile flow stresses of 3Y-TZP enough to attain superplasticity. The enhanced deformation was explained by suppressed grain growth due to the electric bias effect. However, the mechanism/phenomena of the flash event are still unclear. In order to clarify the effect of electric current on high temperature deformation, therefore, the present study was carried out to examine the tensile behavior of polycrystalline zirconia ceramics under the several temperature and electric field/current conditions.

By applying the DC electric power higher than a critical value E_c, the flash event similar to that of powder sintering occurs even in dense zirconia ceramics. At around 1000 °C, for example, the E_c value is about 100 - 200 mW/mm^3, which is slightly larger than those reported in the powder compacts. For lower than E_c, the applied electric current increases sample temperature depending on the applied value, but does not enhance the rate of deformation. For higher than E_c, on the other hand, the electric current enhances the rate of the deformation to about several times as compared with that of without current conditions. The enhanced deformation cannot be interpreted only by the increment of sample temperatures and is likely to occur by the flash event. After the deformation under the electric current conditions, the tested sample shows slight gray color even under air condition. This suggests that the enhanced deformation would be related to oxygen vacancy formation. In the presentation, we will discuss the detailed current effect obtained at wide range testing conditions.