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Field assisted sintering experiments in air were carried out on multiphase ceramics composed of Al_2O_3, $MgAl_2O_4$ and cubic 8 mol% Y_2O_3 stabilized ZrO_2 (8YSZ) to investigate the grain boundary interactions as well as the sintering outcomes of an applied electric field. The ultimate goal is to develop a method to produce a dense nanocrystalline multiphase oxide ceramic for energy applications in extreme environments, without exposing the material to carbon contamination or a reducing atmosphere as is common in "spark plasma sintering" (SPS). Experiments were carried out in a modified compression furnace in air with an applied DC voltage of 50V/cm or less applied to the sample. Preliminary results with single-phase 8YSZ and three-phase alumina/spinel/8YSZ show that the experimental set up is successful for producing FAST sintered samples, with densification occurring at lower temperatures and shorter times compared to non-FAST sintered samples. Data on densification parameters, minimum sintering temperatures, and high temperature compression behavior under an applied electric field will be presented. Grain size and grain boundary energy measurements using SEM and AFM will be compared for FAST three-phase samples and control three-phase samples sintered without an applied electric field.