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ABSTRACT:

Interplay of Sintering, Space Charge, Segregation and Grain Boundary Conductivity in Perovskite Ceramics

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Sinterng, grain growth and segregation are among the oldest problems of metals research with many of the fundamentals being devewlloped in the 50s to 60s. Different phenomena including segregation and solute drag play an important role. While in ceramics, the physics are mostly the same as in metals, the world gains one more complication: charge. This is particularly relevant for the properties, where the diffusion of charged ions can be used in applications such as batteries or solid-oxide fuel cells. However, processing and properties involves a complex relationship between microstructure evolution (i.e. sintering and grain growth) and properties (i.e. conductivity), and both are influenced by segregation and the resulting charge distribution at grain boundaries (called space charge).

In this study, a correlation between the conductivity, space charge layers, solute drag, sintering and non-Arrhenius grain growth in SrTiO3 is presented. Strontium titante is known for its non-Arrhenius grain growth where grain growth rates decrease by orders of magnitude with increasing temperatures between 1350 ◦C and 1425 ◦C. Here, undoped SrTiO3 was sintered and annealed at temperatures below and above the grain growth transition. The influence of the annealing temperature and time on the conductivity and space charge layers at grain boundaries (GBs) in SrTiO3 was investigated by electrochemical impedance spectroscopy (EIS). STEM-EDS analysis indicates the presence of GBs with qualitative different cationic segregation in SrTiO3, which agrees well with the impedance results. The presence of two GB types as indicated by impedance and STEM-EDS correspond well with microstructure evolution, where solute drag and segregation was supposed to cause the non-Arrhenius grain growth behavior of SrTiO3.