

Field assisted sintering of oxide ceramics

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Spark Plasma Sintering (SPS) or Field Assisted Sintering Technique (FAST) has been attracting large interest in the materials science community for the last years (especially to produce refractory metals, composites and ceramics). Faster densification and higher final density with smaller grain growth have been achieved by using this consolidation method. However, these comparisons have most of the time been made with free sintering, totally neglecting the effect of the mechanical compressive stress applied during that process. In addition, the mechanisms responsible for the densification involved during field assisted sintering have not been completely clarified yet.

This presentation will give an overview of the specific phenomena in SPS/FAST. Effects of heating rate (in particular high heating rate), mechanical pressure and electric field will be discussed. The experimental approach we adopted may be simple, but efficient. Hot pressing was directly compared with FAST by using the same processing conditions (heating rate, dwell time, applied pressure, atmosphere and sample geometry). Different materials were tested, from insulator, ionic conductor to semiconductor. Densification behavior can thus be investigated as well as microstructure evolution (in particular grain growth). Shrinkage rate and activation energy for densification can be determined and compared. Differences and similarities between HP and FAST will be highlighted in the talk, including the importance of the temperature control.