# ADVANCED CERAMICS BY SPARK PLASMA SINTERING: SOME RECENT DEVELOPMENTS (INVITED)

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Spark Plasma Sintering (SPS) is gaining significant attention in the last years. This technique is found to show interesting specific non-thermal effects such as generation of spark effects accompanied by plasma states, formation of hot spots, heating from inside to outside as for the microwave heating and activated electro diffusion. Although these effect are still under debate and require further experimental confirmation, apparently they contribute, pending on materials, to the fast and efficient consolidation of the difficult-to-sinter materials and promote or suppress certain growth processes. The SPS technique can be considered unconventional and far from equilibrium leading to both advantages and disadvantages. The consequences are generation of bulks with specific morphologies influencing the grains and the grain boundary features. These morphologies often composed of nanoscale grains can provide enhanced or new functional characteristics otherwise not observed in ceramic obtained by other techniques.

In our presentation we shall discuss some recent developments for some advanced nanoceramics obtained by SPS.

One class of materials are solid electrolytes such as LSGM, GDC, and YSZ. For these materials in the last 10years we produced nanosized powders and obtained by SPS high density samples with particle size down to 10 nm. We shall discuss the ionic conductivity data vs. technology for such ceramics and implications. Our powders and bulks have shown also excellent catalytic and mechanical properties with superior properties than for similar commercially available materials. In some cases we shall present SPS processing of multilayered composite structures for SOFC.

Another class of materials is carbide-nitride composite ceramic obtained by SPS. Namely, we shall pay attention to processing and properties of titanium aluminum and boron based ceramics and composites. New possibilities and strategies of the grain and grain-boundary structure manipulation will be presented.

Finally, the resulted knowledge allows us to address few aspects related to preparation of the powders to be optimally processed by SPS. Among them are the details of powder morphology manipulation, chemical treatment of the powders (e.g. for surface modification) or physical treatment of the powders (deagglomeration, homogenization, surface physical modification), etc.