COOL-SPS: PULLING DOWN THE TEMPERATURE, PUSHING UP THE REACTIVITY

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The use of materials, especially in the field of electronics, but also for catalysis, health (…), requires the control of their shaping (dense or porous materials, spherical or anisotropic particles…). This objective is frequently reached through the preparation of ceramics by conventional, high temperature sintering. Spark Plasma Sintering (SPS) is a particularly efficient densification method, initially dedicated to refractory materials, that is now extremely versatile and allows for the elaboration of nanostructured and/or transparent ceramics, among many other applications.
The recent acquisition of a proof of concept concerning the sintering of fragile ferroic materials by Cool-SPS [1,2,3] has allowed for the exploration of the opportunities associated with Cool-SPS efficiency at low temperature (typically T<400°C). Among the opportunities explored, that this communication intend to cover, are:

- The efficiency of Cool-SPS at very low temperatures, 100°C and below
- The sintering of hydrates [2]
- The synthesis and/or reactive sintering using Cool-SPS
- The diversification of the class of materials sinterable by Cool-SPS (*e.g.* Molecular Materials…)

The input from these exploratory studies will also be investigated, in an attempt to get a better insight on the sintering mechanism at play with Cool-SPS, which was found remarkably complex in the case of $MnSO_4$ [2]. An attempt will also be made to discuss the opportunity represented by Cool-SPS to develop more sustainable materials and processes, essentially through energy efficiency.
In the end, this communication aims at illustrating (see figure below) the remarkable efficiency of Cool-SPS, the large fields it opens for exploratory research centered on fragile materials, and its complementarity with others (low-)temperature sintering methods that may prove crucial for the understanding and optimization of sintering methods and strategies.

[1] T. Hérisson de Beauvoir et al, J. Mater. Chem. C., 2018, 6, 2229
[2] T. Hérisson de Beauvoir et al, J. Eur. Ceram. Soc., 2018, 38(11),3867
[3] T. Hérisson de Beauvoir et al, Ceramics International, https://doi.org/10.1016/j.ceramint.2018.12.103

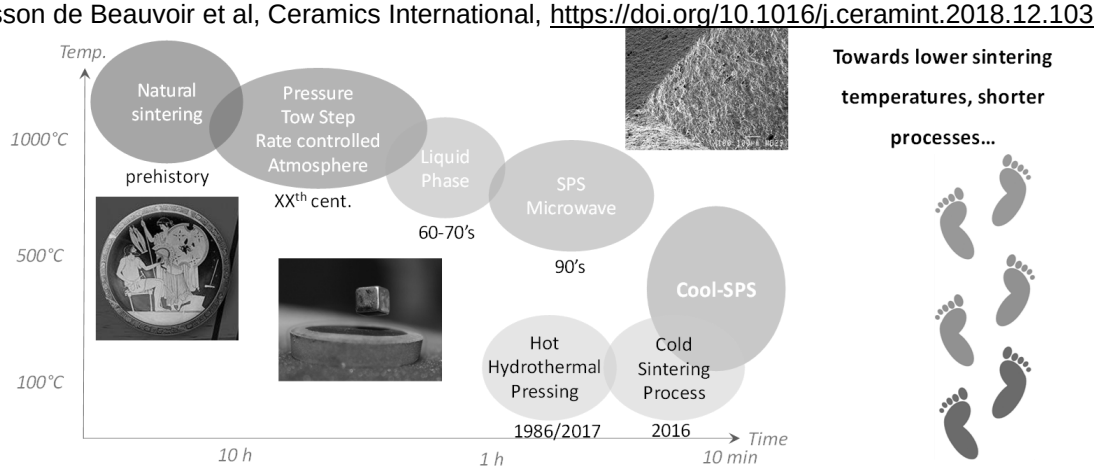

Figure 1 – Schematic time-temperature mapping of sintering methods