

Thermo-Electric Phenomena in Spark Plasma Sintering

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KEYWORDS: *Spark plasma sintering, overheating, Joule effect, Thermo-electric coupling*

SPS is a powder consolidation process that employs electric current to generate heat (Joule effect) while simultaneously applying pressure to achieve densification. In conductive powders, as current flows through the network of particles, it can concentrate at interparticle contacts/necks due to high resistance. This may result in high current densities and local temperature increase (overheating). Such thermo-electric effects can influence microstructure and hence properties.

In this work, thermo-electric phenomena during SPS are investigated through a combined experimental and numerical study. NiAl powder is consolidated at different temperatures. The resulting microstructures are characterised using XRD, SEM and EBSD, with particular focus on particle contact regions that are most susceptible to local overheating. To complement the experiments, thermo-electric finite element simulations are performed using representative three-particle geometries with different neck sizes.

The combined experimental and numerical results indicate that the resulting overheating in NiAl is limited and insufficient to induce partial melting or microstructural changes under the investigated conditions. These findings contribute to a clearer understanding of thermo-electric phenomena in SPS and suggests that a numerical model of SPS can be simplified.

ACKNOWLEDGEMENT: Research funded by National Science Centre, Poland, project no. 2019/35/B/ST8/03158.

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