Szymon Nosewicz[1], Grzegorz Jurczak[1], Witold Chromiński[2], Jerzy Rojek[1], Kamil Kaszyca[3], Marcin Chmielewski[3]
[1]Institute of Fundamental Technological Research PAS, Warsaw, Poland
[2]Warsaw University of Technology, Warsaw, Poland
[3]Łukasiewicz Research Network – Institute of Microelectronics and Photonics, Warsaw, Poland

Quantitative Analysis of Influence of SPS Process Parameters on the Porous Materials Structure Using Combined EBSD and Computer Assisted Software

Abstract

The proposed study demonstrates the experimental, numerical, and theoretical attempt to describe the microstructure of nickel aluminide (NiAl) samples manufactured by spark plasma sintering using electron backscatter diffraction and computer-assisted software. The purpose of the paper was to present the evolution of the structural microscopic and macroscopic parameters – grain size, shape and boundary contact features – and their relation to the main SPS process parameters – temperature and pressure. The use of the electric current and the additional external pressure results in significant changes in the microstructure of the samples, such as the occurrence of lattice reorientation resulting in grain growth, an increase in the grain neighbors, or the evolution of grain ellipticity, circularity, grain boundary length, and fraction [1]. Moreover, the numerical simulation of heat conduction via a finite element framework was performed to analyze the connectivity of the structures evaluating local heat fluxes, deviation angles, and effective thermal conductivity and studying them in the context of the microstructural porosity. Finally, the effective thermal conductivity of 2D EBSD maps was compared with those obtained from FEM simulations of 3D micro-CT structures [2]. The relationship between the 2D and 3D results was derived by using the analytical Landauer model.

Literature:

[1] Nosewicz S. et al. Metall. Mater. Trans. A: Phys., 53, pp. 4101-4125, 2022.
[2] Nosewicz S. et al. Int. J. Heat Mass Transf., 194, pp. 123070-1-19, 2022.

Acknowledgement

The authors would like to acknowledge the financial support of the National Science Centre (DEC-2019/35/ B/ST8/03158).