ICSMA19 Metz, France, June 26 - July 1, 2022
International Conference on Strength of Materials

Mechanically and magnetically induced strain in additive manufactured NiMnGa-based shape memory alloys

W. Maziarz,[a] A. Wójcik,[a,] R. Chulist[a] A. Szewczyk[a], M. Kowalczyk[b], N. Schell[c,] P. Czaja[a], Ł. Żrodowski[b], and R. Wróblewski[b]

[a]The Aleksander Krupkowski Institute of Metallurgy and Materials Science Polish Academy of Sciences, 25 Reymonta St., 30-059 Kraków, Poland
[b]The Faculty of Materials Science and Engineering Warsaw University of Technology 141 Wołoska St., 02-507 Warsaw, Poland
[c]Institute of Materials Physics, Helmholtz-Zentrum Geesthacht, Max-Planck-Strasse 1, Geesthacht D-21502, Germany

[a]w.maziarz@imim.pl

The selective laser melting (SLM) process was applied to fabricate NiMnGa-based polycrystalline samples. The initial powders were firstly prepared by ball milling process producing a fine particle size of about 20 µm. SLM tends to produce samples with a layered microstructure and strong fiber <100> texture parallel to the heat flow direction. It is shown that the resulting crystal structure is strongly dependent on chemical composition and printing parameters associated mostly with Mn evaporation. As a result, three distinct types of martensite crystal structures exhibiting magnetically and mechanically induced strain were obtained (10M, 14M and NM). Furthermore, the samples are deformed along two main texture components showing a strong asymmetry in strain and stress levels independently of crystal structure. The strong asymmetry is related to two deformation modes linked with twin propagation and twin nucleation. Moreover, the chemical composition, crystal structure and crystallographic texture abruptly change when laser oscillation mode is selected.

Keywords: Selective laser melting; Magnetic field-induced strain; Texture, EBSD, TEM.

Acknowledgment: The financial support by National Centre for Research and Development of Poland is acknowledged for funding (TECHMATSTRATEG 2/410941/4/NCBR/ 2019).