Precipitate model for alloy 718 applied for an additive manufactured component

M. Fisk [*], A. Malmelöv[†], A. Lundbäck[†] and L.-E. Lindgren

[*] Materials Science and Applied Mathematics
Malmö University, SE-205 06 Malmö, Sweden
e-mail: martin.fisk@mau.se

[†] Mechanics of Solid Materials
Luleå University of Technology, SE-971 87 Luleå, Sweden
e-mail: andreas.malmelov@ltu.se, andreas.lundback@ltu.se, lel@ltu.se

ABSTRACT

In precipitation hardening alloys, such as in alloy 718, its yield strength is highly affected by the particle size distribution and its number density. Consequently, the volume fraction of the nucleated particles needs to be taken into account when describing the stress-strain behavior in thermo-mechanically loaded samples. In additive manufacturing the volume fraction is of typically interest since components are built by adding layer by layer of material. With this technique, the material experiences different temperature histories in different regions of the sample, and the phase composition will vary across the final component. In this case, modelling is very important tool for further success. Using the finite element method, the thermo-mechanical-metallurgical response to the heating cycles of AM production can be computed.

In this work, a precipitation model for alloy 718 has been developed and applied to simulate the particle volume fraction in each integration point for a simple AM component. It is believed that the final residual stress state and the geometry of the component can be predicted better by using a model that takes the variation of hardened precipitates into account. The particle size distribution and number density in the component is verified by using high energy synchrostron diffraction experiments.