9th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMA2024)
June 3-7, 2024, Lisbon, Portugal

MULTISCALE MODELING OF COMPLEX MIRCOSTRUCTURES

1600

S. HELLEBRAND[*], T. KAISER[#] AND J. WAIMANN[†]

[*] Institute of Mechanics, Faculty of Engineering, University of Duisburg-Essen
Universitätsstr. 12, 45141 Essen, Germany
sonja.hellebrand@uni-due.de, www.uni-due.de/mechanika

[#] Institute of Mechanics, Department of Mechanical Engineering, TU Dortmund University
Leonhard-Euler-Str. 5, 44227 Dortmund, Germany
tobias.kaiser@tu-dortmund.de, www.im.mb.tu-dortmund.de

[†] Modeling and Simulation Techniques for Systems of Polycrystalline Materials,
Institute of Applied Mechanics, RWTH Aachen University
Mies-van-der-Rohe-Str. 1, 52074 Aachen, Germany
johanna.waimann@ifam.rwth-aachen.de, www.ifam.rwth-aachen.de

Key words: Multiscale Simulations, Coupled Problems, State-of-the-art Solution Approaches.

ABSTRACT

In recent years, the industry's demand for materials has increased enormously. As a result, the focus of current research efforts is on the utilisation of complex materials with tailored properties and superior performance under given multi-physical loading conditions. However, due to their large influence on the individual material behaviour, the consideration of the underlying microstructure and lower-scale processes in numerical simulations is almost indispensable. The heterogeneity of the microstructure in general poses a particular challenge with regard to numerical modeling. Microstructure changes induced, amongst others, by phase transformations, dynamic recrystallization and dislocation movement are of particular importance to make reliable predictions of the material behaviour. Similarly, the consideration of multi-physics phenomena such as thermo-mechanical, electro-mechanical or electro-chemical couplings poses challenges while the efficiency of the numerical models plays a crucial role so as to save time, costs and resources.

Against this background, this mini-symposium deals with the description of microstructural changes in the context of multiscale material modeling. Particular focus is on but not limited to:

- Multiscale modeling of evolving microstructures (plasticity, phase transformation, …)
- Multiscale modeling of coupled problems (mechanical, thermal, electrical, …)
- Efficient solution approaches for unit-cell problems (FFT, model order reduction, …)
- Characterisation of material properties resulting from microstructural changes
- Generation of Representative Volume Elements
- Experimental validation