INVITED SESSION ON

PHASE-FIELD MODELING OF INELASTIC MATERIAL BEHAVIOR AND COUPLED MICROSTRUCTURE EVOLUTION

A. PRAHS[1], D. SCHNEIDER[1,3], B. NESTLER[1,2,3], Y. LE BOUAR[4] AND B. APPOLAIRE[5]

[1] Institute for Applied Materials - MMS, Karlsruhe Institute of Technology (KIT)
Straße am Forum 7, 76131 Karlsruhe, Germany

[2] Institute of Digital Materials Science (IDM), Karlsruhe University of Applied Sciences
Moltkestraße 30, 76133 Karlsruhe, Germany

[3] Institute of Nanotechnology (INT-MSS), Karlsruhe Institute of Technology (KIT)
Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany

[4] Laboratoire d'Étude des Microstructures (LEM), Université Paris-Saclay
ONERA, CNRS, 92320 Châtillon, France

[5] Institut Jean Lamour (IJL), Université de Lorraine
CNRS, F–54000 Nancy, France

andreas.prahs@kit.edu, daniel.schneider@kit.edu, britta.nestler@kit.edu,
yann.lebouar@cnrs.fr, benoit.appolaire@univ-lorraine.fr

KEYWORDS: (MULTI)PHASE-FIELD METHOD, PLASTICITY THEORIES, INELASTIC MATERIAL BEHAVIOR

The (multi)phase-field method is widely established for the simulation of microstructure evolution, since it provides a numerically efficient treatment of moving interfaces without explicit interface tracking. In many applications, however, the diffuse interface is not merely a numerical transition region. It is the region where mechanical compatibility, balance laws, constitutive assumptions, and dissipative processes have to be formulated consistently.

The objective of this invited session is to discuss recent developments in diffuse-interface approaches to inelastic and coupled material behavior. Particular emphasis is placed on the treatment of plastic, viscoplastic, viscous, damage-like, and damage and fracture-related processes within diffuse interface regions, as well as on their coupling to phase evolution, heat conduction, diffusion, and chemical driving forces.

Contributions may address phenomenological or mechanism-based (crystal) plasticity theories, strain inheritance during phase transformations, chemo-mechanical and thermo-mechanical coupling, approaches relating phase-specific fields to an effective/interpolated field, and the relation between sharp-interface and diffuse-interface formulations.

The session aims to bring together researchers working on continuum-mechanical foundations, thermodynamically consistent formulations, numerical implementations, and applications to evolving microstructures in crystalline, polymeric, composite, and multiphase materials.