CHiMaD | Center for Hierarchical Materials Design

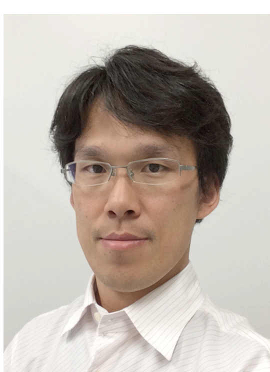
MATERIALS GENOME INITIATIVE SEMINAR SERIES

Multiscale Simulation of Steel and Aluminum Alloy Sheets using Phase Field and Crystal Plasticity Finite Element Methods: *From Microstructure to Sheet Metal Forming*

Prof. Akinori Yamanaka
Tokyo University of Agriculture and Technology, Japan

July 31, 2015 (Friday) | 10.00am
CHiMaD Headquarters, Hogan 1160 (1st Floor)

ABSTRACT The mechanical properties of steel and aluminum alloy sheets are strongly affected by their underlying microstructures. Therefore, it is very essential for controlling the properties of sheet metals to predict microstructure evolutions during recrystallization, phase transformations and so on. Recently, the phase-field method has attracted much attention as one of the most powerful numerical tool to simulate microstructure evolutions in materials. On the other hand, the crystal plasticity finite element method has been widely used for predicting plastic deformation behavior of metallic materials on the basis of its microstructures and crystallographic textures. In our research, we have developed multiscale simulation models to predict microstructure evolutions and plastic deformation behavior of sheet metals using the phase-field and the crystal plasticity finite element methods. In this seminar, some topics of our research will be introduced. The first topic includes a large-scale multi-phase-field simulation of grain growth in a polycrystalline system with finely dispersed second-phase particles using the TSUBAME2.5 GPU-supercomputer of Tokyo Institute of Technology. As the second topic, numerical and experimental investigation of biaxial tensile deformation behavior of a 5000 series aluminum alloy sheet will be presented. In this study, we simulated the biaxial tensile deformation of the aluminum alloy sheet by using the crystal plasticity finite element method based on crystallographic texture data. Furthermore, the yield function and its parameter identified by the simulation were applied to plastic forming simulation of the alloy sheet. The simulation results were experimentally verified using the biaxial tensile test with a cruciform specimen (T. Kuwabara et al., J. Mater. Proc. Technol., 80-81 (1998), 517-523.) and the sheet metal forming test.



Prof. Akinori Yamanaka *is an associate professor at Department of Mechanical Systems Engineering at Tokyo University of Agriculture and Technology, Japan. He received his Ph. D. from Kobe University, Japan in 2008. Dr. Yamanaka worked at Department of Mechano-Aerospace, Tokyo Institute of Technology as an assistant professor during 2008-2012. Dr. Yamanaka published more than 50 papers related to the research on phase-field modeling of diffusional and displacive solid phase transformations in steels [1,2] and crystal plasticity finite element simulation of sheet metal forming. In 2011, Dr. Yamanaka and co-workers won the ACM Gordon Bell Prize Special Achievements in Scalability and Time-to-Solution for the achievement of extreme large-scale phase-field simulation of dendritic solidification in Al-Si binary alloy.*

[1] A. Yamanaka, T. Takaki, ISIJ International, 54 (2014), 2197-2925.
[2] A. Yamanaka, T. Takaki, Y. Tomita, Materials Science and Engineering A, 491, (2008), 378-384.