A Digital Representation of a Microstructure and Determining its Mechanical Behavior

[1]Burak Bal

[1] *Department of Mechanical Engineering, Abdullah Gül University, 38080 Kayseri, Turkey*

[1]burak.bal@agu.edu.tr

Abstract

Mechanical characterization tests might come with a remarkable cost of time and money for both companies and academics. The inquiry to transform laboratory experiments to the computational media is getting a trend; accordingly, the literature supplies many analytical ways to explain the mechanics of deformation. In our work, we focused on the crystal plasticity finite element modeling (CPFEM) analysis on various materials in various crystal structures to predict the stress-strain curve without tensile tests. For FEM analysis, which we used in this study was ABAQUS, a standard user defined material subroutine (UMAT) was prepared. The geometry of a specimen was created via DREAM 3D software with the inputs of Euler angles taken by Electron Back-Scattered Diffraction (EBSD) technique as orientation, or misorientation angles. The synthetic crystal created with DREAM 3D is also meshed in a way the grains inside the crystal meshed separately, and the computer can realize interaction of inter, and intra grain structures. The mechanical deformation parameters obtained from the literature put into the Fortran-based UMAT code to describe how material will response to the load applied from specific direction. The mechanical response of a synthetic crystal created with DREAM 3D agrees well with the material response in the literature.

Keywords: Crystal plasticity, UMAT, Dream.3D, Abaqus.