Polycrystal Plasticity Methods for Texture and Anisotropy: Recent Advances and Perspectives

Ricardo Lebensohn*[1]

[1]Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM 87845, USA – United States

Abstract

Polycrystal plasticity models, largely developed by the texture community since the inception of the ICOTOM conference series, are increasingly used in engineering applications to obtain texture/microstructure/property relationships of polycrystalline materials. These models require a proper consideration of the single crystal plastic deformation mechanisms, a representative description of the microstructure, and an appropriate scheme to connect the microstates with the macroscopic response. The latter can be based on homogenization (e.g., Taylor or self-consistent (SC) methods), which relies on a statistical description of the microstructure, or on full-field solutions, which requires a spatial description of the microstructure (e.g., crystal plasticity Finite Elements (CPFE) or Fast Fourier Transform (FFT)-based methods). Full-field models are numerically intensive, making their direct embedding in multiscale calculations computationally demanding. Alternatively, they can be used to generate reference solutions for assessment of more efficient formulations based on homogenization, semi-analytical theories or, since recently, to train machine-learning (ML)-based approaches. In this talk we will review recent advances on SC and FFT-based polycrystal plasticity models, along with their integration with emerging characterization methods, their embedding in Finite Elements formulations and their use in combination with ML techniques to solve problems involving complex geometries and boundary conditions with microstructure-sensitive material response.

*Speaker