CHiMaD | Center for Hierarchical Materials Design

SPECIAL SEMINAR

MARTENSITIC TRANSFORMATIONS IN ENGINEERING MATERIALS: A MESOSCALE STUDY

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ABSTRACT The martensitic transformation (MT) that occurs in several engineering materials, such as steels, Zirconium (Zr) alloys and Titanium (Ti) alloys leads to some interesting material properties. In the present work a physically based 3D elastoplastic phase-field model is developed to study the MT under various thermo-mechanical conditions in single crystals of steel and Zr-alloys. The input data for the model is acquired from different sources, such as CALPHAD, *ab initio* calculations and experimental measurements. The simulation results clearly show some of the typical characteristics of MT, such as: twinned microstructure formation, autocatalysis, Magee effect (variant selection mechanism under different stress-states) and transformation induced plasticity (TRIP) effect. The study of structure-property relations shows that the stress-states, strain rate as well as the temperature affect the mechanical behavior of steels, giving rise to different yield stresses and hardening behavior. The reverse phase transformation of martensite to austenite during annealing is also studied and the results indicate that the reversed austenite retains, to a large extent, the plasticity inherited from martensite. The omega phase formation in pure Zr and Zr-alloys is also studied. The results show that the omega phase forms as nano-sized particles during the athermal beta (bcc) to omega (hexagonal) phase transformation in Zr-Nb alloys, whereas it forms as laths during the alpha (hcp) to omega (hexagonal) phase transformation in pure Zr under hydrostatic pressure.

Hemantha Kumar Yeddu received his B.Tech. in Mechanical Engineering from Acharya Nagarjuna University in India. He received his M. Sc. And Ph.D. In Materials Science and Engineering from KTH Royal Institute of Technology in Sweden. He is currently a postdoctoral research associate in Theoretical Division of Los Alamos National Laboratory. His main research interests include mesoscale modeling of phase transformations and microstructure evolution using 3D phase-field approach as well as multi-length scale modeling of materials.