ALL ARE WELCOME - Ph.D. SEMINAR TALK 2

Title: Bending and cyclic deformation behavior of engineered magnesium alloys

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Biography of the Speaker:
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Affiliation of the Speaker:
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Abstract:

Magnesium and its alloys have attracted wide attention in various sectors such as automobile, aerospace, electronics and bio-medical industries. This is especially because of their superior strength to weight ratio, electrical and thermal conductivity, vibration damping characteristics and biocompatibility, making them suitable for several futuristic applications. However, magnesium alloys often show yield asymmetry and anisotropy which influences their manufacturing and service life. Yield asymmetry and anisotropy in magnesium-based materials arise primarily due to their inherent HCP crystal structure with complex deformation and hardening phenomena. In the present work, an experimental and simulations-based framework was established to decipher the deformation mechanisms responsible for these anomalies in varying engineered microstructures. The yield asymmetry and anisotropy ratios were investigated in detail for varying microstructural conditions through mechanical testing, microstructural characterization and crystal plasticity-based simulations. Further, yield asymmetry ratios critically influence several sheet metals forming operations, where bending deformation is one of the most prominent loading conditions. During bending deformation, yield asymmetry ratios can lead to migrations of neutral axis in magnesium alloy sheets which cause several anomalies in spring-back characteristics. The multi-scale mechanics of bending process was established across the entire domain of engineered microstructures and yield asymmetry ratios through advanced techniques such as Digital Image Correlations, user defined FEM analysis and in-depth microstructural characterization. The results revealed a thorough theoretical and empirical framework to predict the neutral layer migrations in magnesium alloys with/without yield asymmetry. Lastly, yield asymmetry ratios also have a significant impact on fatigue life of engineering components such as automotive and aerospace structures due to rotating components, compression-decompression cycles, etc. To address this, a comprehensive study was performed on low cycle and high cycle fatigue of the engineered microstructures. The micro-mechanics of cyclic deformation processes were studied under strain-controlled and stress-controlled modes along with advanced crystal plasticity simulations. These observations were supported by detailed microstructural observations which provided suitable insights into the failure mechanisms. Through these studies, a microstructure-based framework was proposed for yield asymmetry and anisotropy behavior of magnesium alloys under varying loading conditions ranging from uniaxial, bending and cyclic strain paths.