

**Distinguished Lecture Series**  
presents  
**“Mathematical Design of Energy Materials”**  
***Professor Ananya Balakrishna***

University of Southern California

***Abstract***

We live in a world in constant need of better materials for energy conversion and storage. We need to not only discover energy materials with enhanced properties, but we need to do so urgently—that is, there is a need to establish a quantitative design framework to accelerate materials development. Finding design principles to improve material properties is the focus of my research group. In my talk, I will present our research on, first, how microstructural instabilities and fundamental material constants contribute to hysteresis in soft magnets. We have developed a coercivity tool that, for the first time, combines micromagnetics and nonlinear stability analysis to predict hysteresis in magnetic alloys and, thereby, provides crucial insights into the longstanding permalloy problem in soft magnets. Second, I will share some of our work on crystallographically designing microstructures to mitigate degradation in intercalation materials. While suppressing chemo-mechanical degradation has been a longstanding problem, our ongoing work initiates a new line of research by drawing inspiration from shape memory alloys to crystallographically design structural transformations. Finally, I will conclude by showing some ongoing work on designing microstructures in photo-induced phase transformation materials. These materials undergo extreme deformations on exposure to light and are an emerging class of phase transformation materials with applications in remote actuation. Throughout, I will emphasize how developing multi-physics and multi-scale mathematical methods (e.g., phase-field methods, phase-field crystal methods) allows my group to answer new questions about how microstructures affect material properties.

***Biography***

Ananya Renuka Balakrishna joined the Department of Aerospace and Mechanical Engineering at USC as an Assistant Professor in Fall 2020. Prior to joining USC, she pursued postdoctoral research as a Lindemann Fellow at MIT (Department of Materials Science), and at the University of Minnesota (Aerospace Engineering and Mechanics). Ananya received her PhD in Solid Mechanics and Materials Engineering from the University of Oxford. Broadly, her research focuses on developing mathematical models to investigate the links between material instabilities, microstructures and properties in energy-storage and functional materials.



**October 4, 2022**  
**4:00P.M.**  
**Location: ZHS 352**