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SCHOOL OF
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College of Engineering, Architecture and Technology

MMME SEMINAR SERIES

Creation of High Entropy Alloy Nanoparticles via Non-equilibrium Laser Processing

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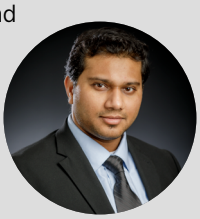
Dr. Ritesh Sachan is an Associate Professor in the Department of Mechanical and Aerospace Engineering at Oklahoma State University. His research focuses on uncovering the evolution mechanisms and structural transformations in nanoscale high-entropy materials through the combined use of thin-film science, nanosecond laser processing, and advanced electron microscopy. A major highlight of Dr. Sachan's recent work is the development of a nanosecond laser–driven approach for fabricating material libraries of high-entropy alloy nanoparticles, a rapidly emerging class of materials with transformative potential for energy and catalytic applications. Dr. Sachan earned his Ph.D. from the University of Tennessee, Knoxville, and previously served as an NRC Research Fellow at the U.S. Army Research Office and a Postdoctoral Researcher at Oak Ridge National Laboratory. He has received numerous honors, including the NSF CAREER Award, ASM-IIM Lectureship Award, National Research Council Fellowship from the National Academy of Sciences, and the TMS Young Leader Award. To date, he has authored nearly 100 journal publications and delivered numerous invited and conference talks, reflecting his substantial contributions to the fields of nanomaterials, thin-film science, and laser-driven materials synthesis.



ABSTRACT

One of the most effective ways to achieve novel structures and functionalities in nanomaterials is by adopting fabrication methods far from equilibrium conditions. Ultrafast laser processing is one approach based on ultrafast structural reordering at the nano/atomic scale, giving rise to novel nanostructures. In this talk, we present the creation of high entropy alloy (HEA) nanoparticles using nanosecond pulsed laser processing that has gained a great deal of attention due to their promising properties relevant to energy-relevant applications. HEAs typically consist of homogeneously mixed constituent elements in equiatomic or relatively large proportions. However, they are challenging to fabricate via conventional equilibrium techniques. Here we discuss how pulsed laser melting of ultrathin alloy films can be a powerful but simple and cost-effective technique to fabricate HEA nanoparticles. Ultrathin metal films (1-30 nm) on inert substrates like SiO2 are generally unstable, with their free energy resembling that of a spinodal system. Such films can spontaneously evolve into predictable nanomorphologies with well-defined length scales. We review this laser-based experimental technique and provide examples of resulting robust nanostructures that can have applications in catalysis and optics.

PIZZA LUNCH PROVIDED

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