Materials Research Seminar

Texas Center for Superconductivity at the University of Houston

Center for Integrated Bio and Nano Systems

Ultrahigh-Temperature Manufacturing of High Entropy Alloys

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Online only: 2:00 – 3:00 pm

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Prof. Xizheng Wang
Department of Mechanical and Aerospace Engineering,
University of California, Irvine

Abstract:
Traditional industrial processes heavily rely on fossil fuels to generate thermal energy, leading to high CO_2 emissions (>35 billion tons/year) that contribute to global warming. Electrified processes, powered by renewable energy sources, are becoming more sustainable and cost-effective. In this presentation, I will discuss the use of electrified ultrahigh-temperature heating as an alternative to traditional fossil fuel-based manufacturing. This process achieves ultrahigh temperatures through Joule heating (up to 3000 K), with rapid heating and cooling rates (10^5 K/s), and high temporal and spatial resolution. These conditions are especially ideal for non-equilibrium syntheses, enabling the fabrication of materials in metastable states that are not accessible at thermodynamic equilibrium conditions. I will discuss the use of this disruptive electrified Joule heating platform for the design, synthesis, and manufacturing of a variety of advanced materials, including support-free high entropy alloy nanoparticles for applications in energy and catalysis. The process also allows for morphology control of nanoparticles during rapid heating, resulting in the synthesis of hollow high entropy alloy nanoparticles, which feature a high ratio of active sites per mass for catalysis. In addition to nanomanufacturing, I will also discuss the exploration of the electrified ultrahigh-temperature platform for the direct melt printing of bulk multi-principal elemental alloys towards metal additive manufacturing. The ultrahigh-temperature, non-equilibrium process is crucial for preventing phase separation and achieving the formation of single-phase high entropy alloys. This electrified ultrahigh-temperature platform offers a promising tool for new materials research and manufacturing in emerging energy and environmental technologies.

Bio: Dr. Xizheng (Zoe) Wang is an Assistant Professor in the Department of Mechanical and Aerospace Engineering at the University of California, Irvine, as of 2023. Prior to joining UCI, Dr. Wang held the position of Assistant Research Scientist in the Department of Materials Science and Engineering and the Center for Materials Innovation at the University of Maryland, College Park. Dr. Wang received her B.S. in Chemical Physics from the University of Science and Technology of China in 2013 and her Ph.D. in Chemistry from the University of Maryland, College Park in 2018. During her doctoral studies, Dr. Wang focused on exploring the fundamental mechanisms behind the strong reactivity of oxidizers in energetic reactions using ultrafast and ultrahigh-temperature apparatus. After earning her Ph.D., she joined the Department of Materials Science and Engineering at the University of Maryland as a postdoctoral researcher. She has received the DOE ARPA-E IGNIITE award and ACS PRF Doctoral New Investigator award.