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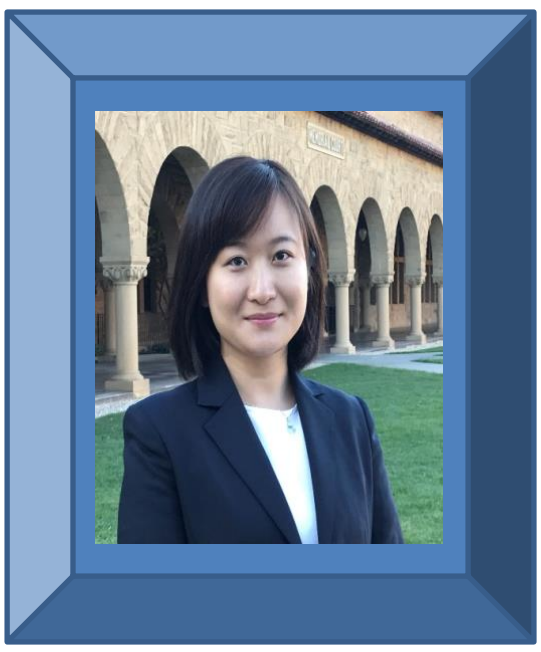

Bridging Thermal Science and Nanomaterials for Sustainable Energy Applications

Lili Cai,
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Date: Monday, April 16 at 11am

Location: ECCS 1B28

Abstract:

As population and living standards increase, the energy demand and climate change have reached unprecedented levels that require more efficient technologies to be developed. Nanostructured functional metal oxides have been shown to significantly enhance the performance of many energy conversion devices. However, translation of their advancement into practice has been hindered by the high cost and complexity of large-scale manufacture. In the first part, I will talk about the flame-based synthesis method for growing metal oxide nanomaterials at rapid rates and atmospheric condition. This method can enable large-scale production of oxide nanomaterials to advance many applications, including solar water splitting, catalysis and electronics. As an example, a nanostructured photoanode was designed and flame-synthesized for photoelectrochemical (PEC) water splitting to produce H_2 fuel and store solar energy. By simultaneously improving light absorption, charge transport and surface reaction kinetics, this flame-synthesized photoanode demonstrated high PEC performance, which was among the best of oxide-based photoanodes. Solving the energy problems not only relies on the development of renewable energy technologies, but also necessitates the reduction of current energy consumption. Personal thermal management, providing heating and cooling only to the human body, offers a promising strategy to mitigate the enormous energy consumption for indoor temperature regulation. To achieve localized heating and cooling, the thermal radiation emitted by human body is an essential aspect to consider. In the last part, I will present my current research efforts on material design and structural engineering to achieve passive regulation of radiation heat transfer between the human body and the environment. All of these works demonstrate the new possibilities of bridging thermal science and nanomaterials for achieving a sustainable energy future.

Bio:

Dr. Lili Cai is currently a postdoctoral fellow in the Department of Materials Science and Engineering at Stanford University, working on novel composite materials with advanced thermal radiation properties for personal thermal management. She received her B.S. in Materials Chemistry from University of Science and Technology of China, and her M.S. and Ph.D. in Mechanical Engineering from Stanford University, with the Stanford Graduate Engineering Fellowship. Her Ph.D. research focused on developing flame-based synthesis methods for scaling up the production of oxide nanomaterials to advance their application in solar water splitting, catalysis and electronics.

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