THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT SPRING COLLOQUIUM SERIES PRESENTS:

2021 John E. Dorn Lecture

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From Computer Chips to Catalysts: Precise Materials Synthesis for Sustainable Energy Applications

With the growing demand for energy at the global scale coupled with a need to mitigate its environmental impact, there is strong interest in developing new and more efficient energy technologies. Efforts in the development of such sustainable energy technologies can be broadly classified into three categories: energy capture, especially from the sun due to the abundance of solar energy; energy storage, typically in the form of chemical bonds; and efficient energy consumption. The requirements to achieve these energy conversion processes with high efficiency has in turn motivated the need to design and construct materials at the nanoscale. Among the many synthetic strategies that are being applied to create these nanoscale components, atomic layer deposition (ALD), a technique widely used for making computer chips, has now emerged as one of the most exciting tools for the study, design, and fabrication of energy materials with improved properties and performance. This talk will describe our research applying ALD to the study of energy conversion devices, with focus on using the layer-by-layer synthesis permitted by ALD to generate the nanoscale materials with a high level of control over composition, structure, and thickness. I will present our work on photovoltaics, in which nanometer-scale interfacial layers are explored for both single junction and tandem perovskite solar cells. Metal oxide layers such as vanadium oxide and tin oxide are shown to provide beneficial properties to the metal halide perovskite devices. A second example is the development of efficient catalysts that can drive the chemical conversion of renewable resources into useful products. One promising pathway is the catalytic conversion of synthesis gas (syngas,$CO + H_2$) into oxygenates such as ethanol. I will describe how atomically-precise ALD titration of additive components onto supported metal catalysts allows for the tuning of activity and selectivity and provides new insights into structure-property relationships in these systems. The outlook for atomic scale surface modification using ALD to synthesize and study these important classes of energy conversion materials will be discussed.

Stacey F. Bent is the Jagdeep and Roshni Singh Professor at Stanford University, where she is Professor of Chemical Engineering and Professor, by courtesy, of Chemistry, of Materials Science and Engineering, and of Electrical Engineering. She also currently serves as Vice Provost for Graduate Education and Postdoctoral Affairs. Bent obtained her B.S. degree in chemical engineering from UC Berkeley and her Ph.D. degree in chemistry from Stanford, and she was a postdoctoral fellow at AT&T Bell Laboratories. Bent's research interests are in the understanding of surface chemistry and materials synthesis and the application of this knowledge to a variety of problems in sustainable energy, semiconductor processing, and nanotechnology. Her group's research on atomic layer deposition (ALD) ranges from fundamental mechanistic studies to applications in solar cells, fuel cells, catalysts, batteries and area selective ALD. Bent was elected to the U.S. National Academy of Engineering in 2020. She is also a Fellow of the American Chemical Society (ACS) and the American Vacuum Society (AVS). She received the ACS Award in Surface Chemistry in 2018, the SRC Technical Excellence Award in 2020, and the ALD Innovator Award in 2021.

Tuesday, May 4 • 4 pm CT • Zoom

Registration is required. RSVP here.

Questions? Contact Kristina.lugo@northwestern.edu.