Department of Chemical and Environmental Engineering

2016—2017 Colloquium Series

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9:30-10:30 AM

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Syed Mubeen

Assistant Professor

Chemical and Biochemical Engineering Department

University of Iowa

Towards Cost Competitive Electrochemical Energy Conversion and Storage Systems

Abstract: Becoming more energy sustainable is a major current societal goal, which, of necessity, involves greater use of sunlight as a primary source of energy. However, if solar energy is ever to displace fossil fuels as our main energy source, it could only do so if we solve the energy storage problem.

The first portion of the talk will introduce our research efforts to develop novel materials and systems to convert light energy directly into high free energy materials that can be used as fuels and chemicals, thereby storing the solar energy in a high energy density and transportable form. The photoelectrochemical systems were developed utilizing several potential concepts including: (i) semiconductor and/or Schottky junction based nanostructures employing earth abundant elements (e.g. SnS photocathodes; BiVO4/WO3 photoanodes); (ii) low-cost electrochemically manufactured multi-junction cell (e.g. CdTe based multijunction cells) and (iii) oxide encapsulated stable photoelectrochemical nanoreactors. The systems created were able to generate high value oxidation (Cl2 and Br2) and reduction (H2) products sustainably for at least six hours in acidic medium.

The second part of the talk will focus on our efforts to develop grid-scale energy storage device that integrates technical advantages of redox flow batteries and non-Li sold electrode batteries into a single device. Technically, our approach replaces the traditional aqueous solution of redox-active molecules found in typical redox flow batteries with circulating hydrophilic carbon particles (“flowable electrodes”) coated with earth-abundant redox-active solids. The above concept was successfully used to demonstrate several non-Li-based battery chemistries including zinc-copper, zinc-manganese oxide, zinc-bromine, and zinc-sulfur, providing a pathway for potential applications in medium and large-scale electrical energy storage

BioSketch: Syed Mubeen is currently an Assistant Professor in Chemical and Biochemical Engineering at The University of Iowa. His research interests center on developing cost-effective materials and systems for electrochemical energy conversion and storage, understanding electrochemical reaction pathways in supercritical environments, and to understand surface plasmon mediated energy generation and transport pathways for photoelectrochemical applications.

Mubeen received his B.Tech in Chemical and Electrochemical Engineering at Central Electrochemical Research Institute, India. He received his Ph.D. in Chemical and Environmental Engineering with Prof. Nosang Myung and Prof. Marc Deshusses at UC Riverside. As a Postdoctoral Scholar at UC Santa Barbara, he studied plasmonic metals and semiconductors for photoelectrochemistry working with Prof. Martin Moskovits, Prof. Galen Stucky and Prof. Eric McFarland. He is also associated with two start-up companies, as lead scientist for HyperSolar Inc and co-founder of PANI CLEAN Inc.

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