Advanced Materials and Processes for Addressing Renewable Energy Challenges

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ABSTRACT

Worldwide power demand (about 18 TW) will double by 2050 and triple by end of the century and could lead to significant increase in green house gas (CO_2) concentration in atmosphere to > 800 ppm. In order to keep CO_2 levels at reasonable levels, it is essential to generate electricity and fuels using non-carbon-producing energy sources. Despite progress over the last three decades, many of the available technology concepts suffer from availability of materials and processes. So, the discovery, development, and large-scale, low-cost manufacturing and deployment of advanced energy materials will be a critical research need for the foreseeable future.

The University of Louisville with the help from $20+M endowment pledge from Hank Conn and his wife to setup a center named as Conn Center for Renewable Energy Research to address the above-mentioned grand challenges. In order to address the energy challenges, priority must be given to concepts that are potentially scalable and commercializable. So, the Center's main objective has been to foster development of transformational concepts and accelerate the translation of technology concepts from the lab to pre-commercial scale via large-scale device prototyping. The center's scientific and technical thrusts are devoted in the following areas: Advanced Energy Materials Manufacturing and Characterization; Solar Energy Conversion; Power Electronics; Energy Storage; Biofuels/Biomass Conversions; and Energy Efficiency.

In this presentation, I will highlight and review specific projects @ Conn Center that utilize nanoscale materials and processes toward addressing grand challenges in renewable energy and translational activities through entrepreneurship. This presentation will also review Conn Center's state of the art experimental facilities over 25,000 sq.ft that could be accessed by students and researchers from both academe and industry.

Biosketch of Speaker: Mahendra Sunkara is Director of the Conn Center for Renewable Engineering Research, Professor of Chemical Engineering and Distinguished University Scholar at University of Louisville. Dr. Sunkara received his B. Tech. degree in Chemical Engineering from Andhra University (India) in 1986, a M.S. in Chemical Engineering from Clarkson University in 1988, and a

PhD in 1993 from Case Western Reserve. He did his PhD under guidance of Prof. John Angus on chemical vapor deposition of diamond. He worked at Faraday Technology, Inc. in Dayton, OH, from 1993-1996 as a Project Engineer before joining UofL as an assistant professor in 1996.

His personal research interests include large single crystal growth of diamond, gallium nitride and bulk quantities of nanowires, solar cells, Li Ion batteries, and water splitting. He has published over 150 articles in refereed journals, four book chapters, and was awarded over 25 U.S. patents. He co-authored a book entitled "Inorganic Nanowires: Applications, Properties and Characterization" published by CRC Press. He was awarded the Ralph E. Powe Junior Faculty in Engineering award in 1999 and NSF CAREER award in 1999. In 2002, the *Louisville Magazine* placed him in the list of top 25 young guns in the city of Louisville. In 2009, he received the UofL President's distinguished faculty award for research and United Phosphorus CDS Award from the Indian Institute of Chemical Engineers in 2009. He has been named as Fellow of Kentucky Science and Engineering Foundation in 2017. His research work was cited about 8000 times with an h-index of 44. His work resulted in over twenty US patents. He graduated over 20 M.S/M.Eng and 20 PhD students who found successful careers in academia as faculty at institutions such as RPI, Texas A&M, U of Tulsa, IIT - Hyderabad and in Industry such as Intel, HP, Veeco, Applied Materials, and Lexmark, etc.

He founded Advanced Energy Materials, LLC (AdEM) in 2010 to commercialize his technology on scalable manufacturing of nanowire based materials for catalysts, batteries and absorbents. Prior entrepreneurial activities include founding an IT training and consulting company, Indacle Software, Inc.in 1995 and a lead acid battery manufacturing unit, Chemener Batteries LTd., in India and serves on the board of a publicly traded company, Karuturi Global and serves on the editorial boards of Nanotechnology and Nature Scientific Reports.