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2021 WORLD FUEL CELL CONFERENCE

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Name	Feng-Yuan Zhang
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Invited Keynote Lecture

Presentation Title	**Pathways to highly efficient hydrogen production: manipulating transport and electrochemical reaction with ultralow catalyst loading**
Abstract (Approximately 200 words)	Proton exchange membrane electrolyzer cells (PEMECs) have received increasing attention for efficient hydrogen/oxygen production and energy storage, even at low-temperature operations. It has been strongly desired to promote catalyst activities and utilizations in PEMECs and to optimize their designs with a better understanding of microscale ultrafast electrochemical reactions and interfacial effects inside PEMECs. A novel titanium thin liquid/gas diffusion layer (LGDL) with well-tunable pore morphologies was developed by employing nano-manufacturing, remarkably reducing the interfacial, ohmic, kinetic, and transport losses in PEMECs. In addition, the LGDL thickness reduction from hundreds of μm for conventional LGDLs to tens of μm leads to a decrease in the weight and volume of the PEMEC stack. More importantly, by taking advantage of the novel LGDL coupled with the development of a transparent PEMEC and a high-speed micro visualization system, the rapid electrochemical reactions and multiphase transport inside PEMECs are revealed to occur only on the catalyst layer adjacent to good electrical conductors. Based on these findings, thinfilm catalyst-coated LGDLs (CCLGDLs) are fabricated and exhibit much higher mass activity and catalyst utilization than conventional catalyst-coated membranes. Furthermore, an innovative electrode design strategy is proposed to build electron/proton transport nanohighways to ensure that the whole electrode meets the triple-phase boundary, therefore significantly enhancing oxygen evolution reactions (OERs) and hydrogen evolution reactions (HERs) and promoting inexpensive and earth-abundant electrocatalysts.
Biographical Sketch (Approximately 200 words)	Dr. Feng-Yuan Zhang is a Professor and founding director of NanoHELP in the Department of Mechanical, Aerospace and Biomedical Engineering at UT Space Institute, University of Tennessee, Knoxville. Prior to that, he had experience at University of Delaware, Penn State University, the University of California, Los Angeles and Stanford University. He received his B. S. and M.S. from Nanjing University of Aeronautics and Astronautics and received his Ph. D. from Nagoya University. His research interests lie in thermofluid, micro/nanotechnology, energy, multifunctional materials, advanced manufacturing, propulsion, sensors, and state-of-the-art spectroscopies and diagnostics. He has been team leader or investigator for numerous projects on hydrogen production, oxygen generation, water electrolyzers, fuel cells, pulse detonation engines, arcjet thrusters, electrochemical reduction of CO_2/N_2 to high-value products, and advanced instrumentation. His group develops thin and well-tunable liquid/gas diffusion layers (LGDLs) and catalyst-coated LGDLs (CCLGDL) with desired transport, catalytical, electrical and thermal properties, and investigates *in-situ* microscale ultrafast electrochemical reactions, interfacial effects and microfluidics in electrolyzer cells. Multiple conventional parts are integrated into one multifunctional plate to reduce the weight, volume and component quantity. He has authored/co-authored 4 book chapters and over 100 other publications, and has given over 60 talks. More information can be found at http://fzhang.utsi.edu/default.htm.