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Enabling cost effective hydrogen at low temperatures

This presentation will focus on durable, high-performance materials and interfaces for advanced water splitting, enabling a clear pathway for achieving <$2/KgH$_2$ (on scale) with efficiency of 43 KWh/Kg using anion exchange membrane interface. Advances via fundamental understanding of both hydrogen and oxygen evolution reactions (HER/OER) leading to novel materials will be in conjunction with critical improvements in membrane and ionomers and gas evolution electrodes with corresponding characterization and testing. Progress towards these goals under a three-year multifaceted and comprehensive effort will be described wherein Northeastern University (NEU) will present catalyst development and characterization (both *in situ* and *ex situ*). University of Delaware (UD) will showcase improvements in ionomer and membrane materials. In addition, close collaboration with National Laboratory partners with Lawrence Berkeley National Lab (LBNL) participating in multiscale modeling and computation in close concert with Sandia National Laboratory (SNL) providing MD simulations of the membrane catalyst interface and National Renewable Energy Laboratory (NREL) providing advanced ionomers, durability protocols and validation will be described. Anion exchange membrane electrolyzers (AEMELs) are ideally suited with a low-cost profile enabled by platinum group metal (PGM)-free catalysts, low fluorine content membranes, and a less corrosive environment for cell separators. This presentation will showcase state of the art stable, high-conductivity, and high-strength AEMs, stable and active PGM-free catalysts for hydrogen and oxygen evolution reaction (HER/OER), and high performance electrode architectures that together can unlock the cost advantages of AEMELs. If successful, the developed technology can meet FCTO efficiency targets, delivering carbon-neutral hydrogen at $2/kg while simultaneously enabling higher penetrations of wind and PV electricity on the grid. The overall goal is cell level performance of 1.62 V at 1 A/cm^2, which meets the FCTO efficiency target of 43 kWh/kg. Component performance targets have been established using a porous electrode model to support the overall cell performance target. This is at the modeled scale of 50,000 kg/day and operating at 1 A/cm^2 resulting in hydrogen cost at $2.15, $1.82, or $1.76/kg, respectively (2, 20, 200 plants). In the low-volume manufacturing case, it is still possible to meet the cost target by operating near 2 A/cm^2, sacrificing some efficiency.

Biography

Sanjeev Mukerjee is a college distinguished professor in the department of chemistry and chemical biology and heads the Renewable Energy Technology Center at Northeastern University. He has authored 160 papers in peer reviewed journals and has an H-factor of 65. He holds 9 patents and has enabled several start up companies with membership on their scientific advisory committee.

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