Title

(CRADA) PEM CO2 Electrolyzer Scale-Up to Enable MW-Scale Electrochemical Modules

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Publication Date

2023-03-15

Cooperative Research and Development Agreement (CRADA) Final Report

Report Date: 3/15/2023

In accordance with Requirements set forth in the terms of the CRADA, this document is the CRADA Final Report, including a list of Subject Inventions. It is to be forwarded to the DOE Office of Scientific and Technical Information upon completion or termination of the CRADA, as part of the commitment to the public to demonstrate results of federally funded research.

Parties to the Agreement: Twelve Benefit Corp and Lawrence Berkeley National Lab

CRADA number: FP000140047

CRADA Title: PEM CO2 Electrolyzer Scale-Up to Enable MW-Scale Electrochemical Modules

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Sponsoring DOE Program Office(s):
Bioenergy Technology Office

LBNL Report Number:
LBNL-2001512

OSTI Number:
[SPO to complete]

Joint Work Statement Funding Table showing DOE funding commitment:

DOE Funding to LBNL	500,000.00
Participant Funding to LBNL	
Participant In-Kind Contribution Value	480,725.00
Total of all Contributions	980,725.00

Provide a list of publications, conference papers, or other public releases of results, developed under this CRADA:
(Publications must include journal name, volume, issue, Digital Object Identifier)
There is no publication or other public releases of results.

Provide a detailed list of all subject inventions, to include patent applications, copyrights, and trademarks:

(Patents and patent applications are to include the title and inventor(s) names. When copyright is asserted, the Government license should be included on the cover page of the Final Report)
None

Executive Summary of CRADA Work:

This collaborative project leverages advanced characterization tools at LBNL to investigate the electrode properties including, catalyst loading uniformness, conductivities, porosity, and tortuosity as well as transport media properties including porosity and tortuosity. These measurements and results help bridge the performance and durability gap during electrolyzer scale-up activities at Twelve from small electrodes to large electrodes for megawatt CO2 electrolyzer. The research results also bring fundamental understanding of possible degradation mechanisms that occur under extremely reductive potentials including material and morphological changes. The project will helped accelerate the deployment of megawatt CO2 electrolyzer. The public benefits could include creating jobs and increasing public awareness of potential clean technologies for CO2 sustainable utilization. Ultimately, the project will help national wide effort of flighting climate change and achieving carbon neutrality by 2050.

Summary of Research Results:
This product contains Protected CRADA Information, which was produced on 03/03/2023 under CRADA No. [FP000140047] and is not to be further disclosed for a period of up to and not to exceed five (5) years from the date it was produced except as expressly provided for in the CRADA.
The research results of catalyst layer conductivity measurements helped understand how various electrode fabrication parameters altered the balance between ionic and electronic conductivity in electrodes, which correlates to device efficiency. The post-mortem analysis for electrode conductivity helped diagnose possible degradation mechanisms such as ionomer degradation or catalyst passivation.
The X-ray fluorescence measurements determined catalyst loadings and electrode uniformness, which is critical to durability of large size electrodes. The X-ray computed tomography measurements helped evaluate structural parameters of porous transport media, which can be used as inputs into multiphysics simulations for applied voltage breakdowns. The voltage breakdown identified the source of overpotential for the electrolyzer and provided future design directions for further performance and durability improvements. These measurements of spent samples also helped determine whether porous transport media loses its preferred structural properties, which, when combined with other techniques, revealed dominant degradation mechanisms.