HFTO Postdoctoral Recognitional Award 2021

Yingying Chen

Postdoctoral Researcher

National Renewable Energy Laboratory

04-27-2021

About Me

Hohai University
2009 - 2013

Bachelor
Environmental Engineering
- Fluid characteristics with EFDC modeling

University of Arizona
2013 - 2017

Master
Environmental Engineering
- Removing phosphonate antiscalants from membrane concentrates

University of Arizona
2013 - 2018

Ph.D.
Chemical Engineering
- Techno-economic analysis of BMED
- Bench scale zero-liquid discharge water softening system
- Electrocoagulation to remove dissolved silica
- Alkaline-stable BPM development

National Renewable Energy Laboratory
2018 - present

Postdoc Researcher
Chemical Engineering
- Electrospun BPM development
- Reversible fuel cell with BPM
- Electrochemical CO_2 reduction

About Me

Research Expertise:

bipolar membrane development, electrospinning, MEA fabrication and development for fuel cell/electrolysis/reversible fuel cell, electrochemical CO_2/CO reduction

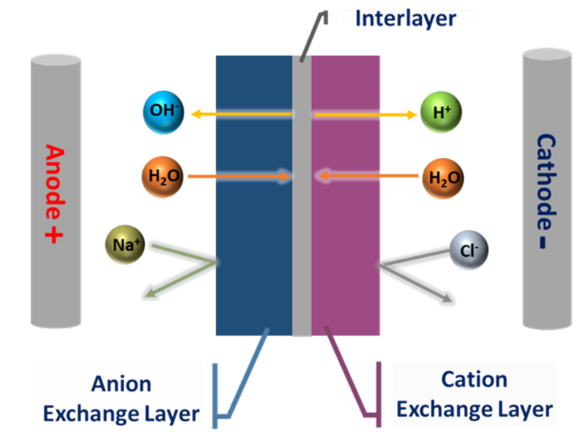
Teaching & Mentorship:

- Research Mentor of the Science Undergraduate Laboratory Internship (SULI) – U.S. DOE
- Research Mentor of the Community College Internship (CCI) – U.S. DOE
- Coach Mentor of Denver Public Schools' CareerConnect Coach Program

Accomplishments:

- 11 peer reviewed papers since 2015, including 8 first-author papers
- 3 oral presentations at professional society conferences
- Exceptional performance in 2019 & 2020 & Key contributor award in 2020 at NREL

BPM Development & Electrochemical Applications

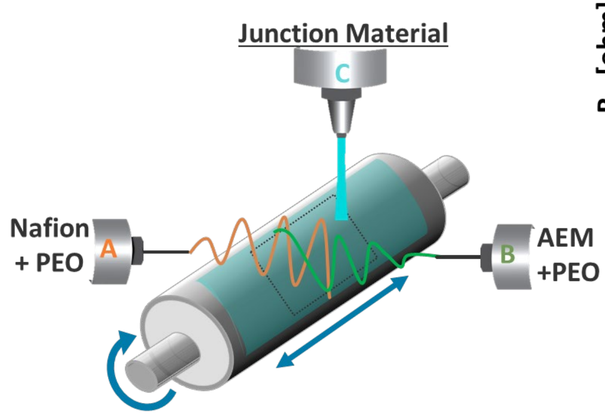


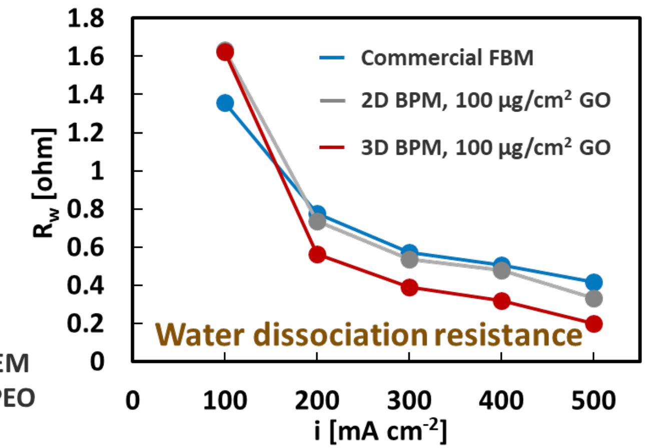
Applications

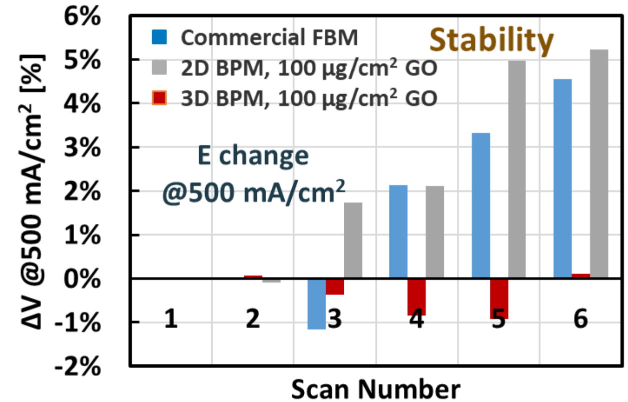
- CO_2 Electrolysis
- Water Electrolysis
- Fuel Cell
- Electrodialysis

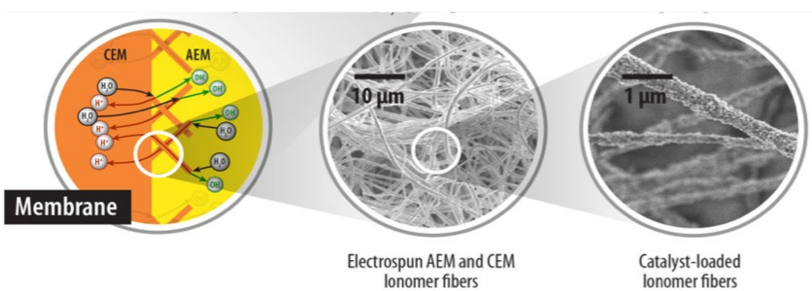
Limitations

- Chemical & Mechanical Stability
- Water Dissociation Efficiency
- Water transport at high *i*







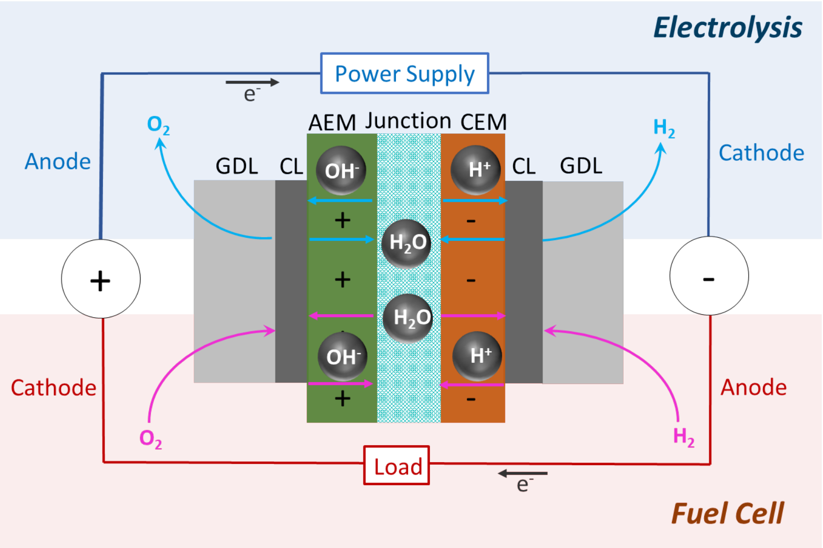


3D electrospun BPM with co-electrospun junction

- Lower water dissociation resistance
- Lower voltage
- Better stability

******ACS Applied Polymer Materials*, 2020

BPM MEA for Fuel Cells and Electrolyzers



- More favorable kinetics for each half-reaction
- Lower catalyst Loading/PGM free catalyst
- Less crossover

➢ Find the optimal BPM junction material for each application

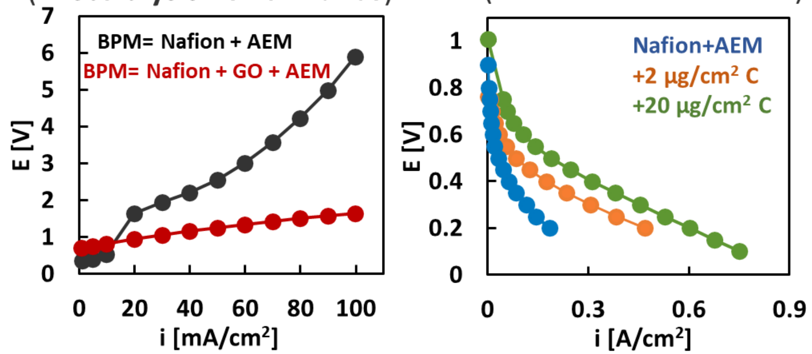
➢ Use modeling to guide the future optimization of BPM junction

BPM Junction Material

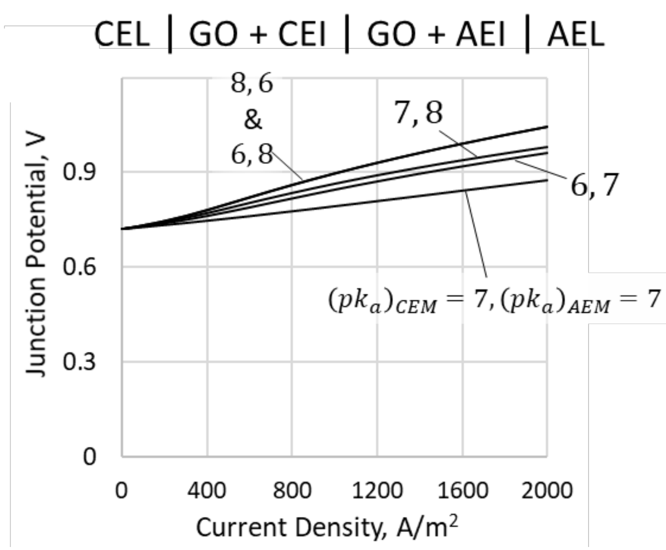
Graphene Oxide (**Electrolysis** Performance)

Carbon (**Fuel Cell** Performance)

Nafion **(Binding)**

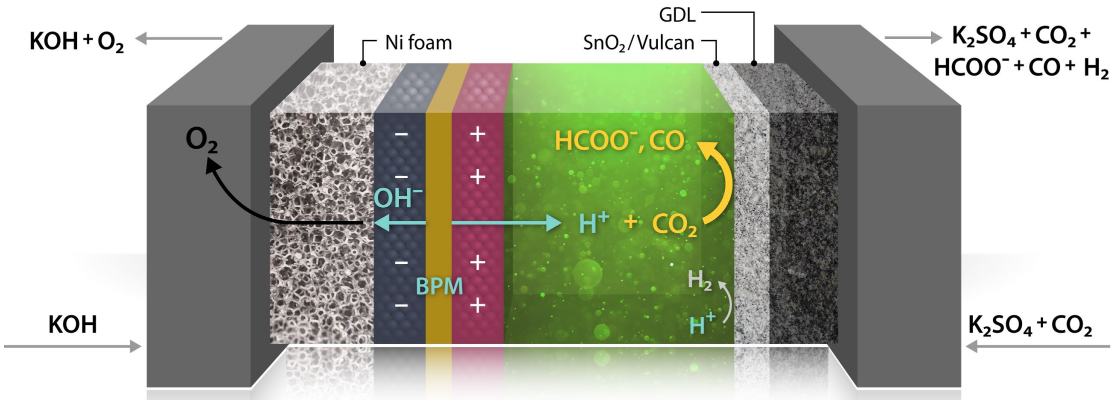


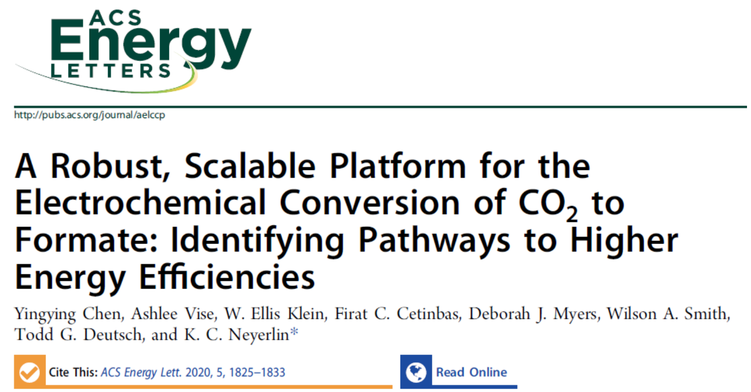
- ➢ With ionomer in junction as binder when C/GO >20 µg/cm²
- ➢ Achieve mechanical strength in junction



Journal of Electrochemical Society, 2020

CO_2R Cell Architecture & Scaling-Up



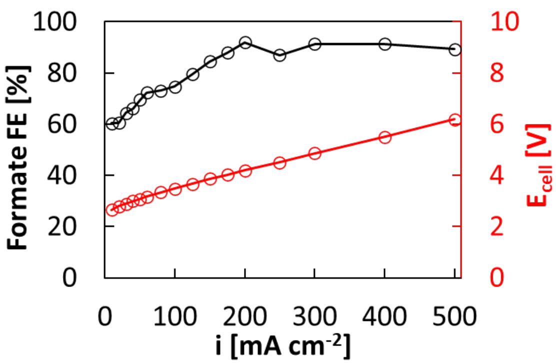

ACS Energy LETTERS

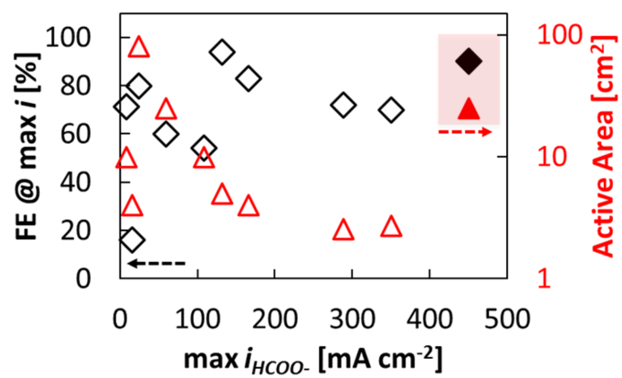
http://pubs.acs.org/journal/aelccp

A Robust, Scalable Platform for the Electrochemical Conversion of CO_2 to Formate: Identifying Pathways to Higher Energy Efficiencies

Yingying Chen, Ashlee Vise, W. Ellis Klein, Firat C. Cetinbas, Deborah J. Myers, Wilson A. Smith, Todd G. Deutsch, and K. C. Neyerlin*

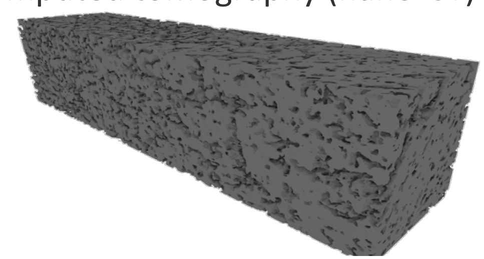
Cite This: ACS Energy Lett. 2020, 5, 1825−1833 | Read Online

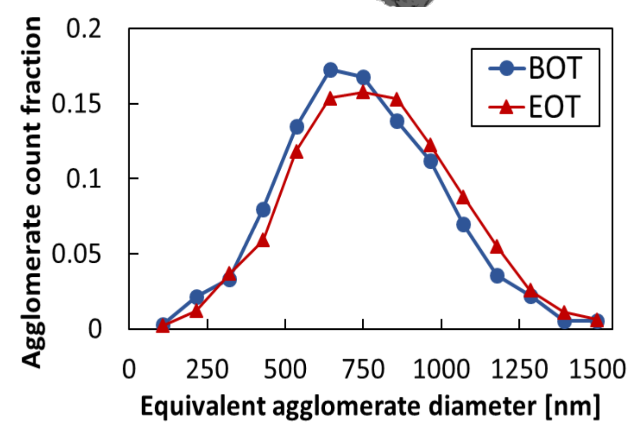




Nano-scale synchrotron X-ray computed tomography (nano-CT)

Argonne NATIONAL LABORATORY

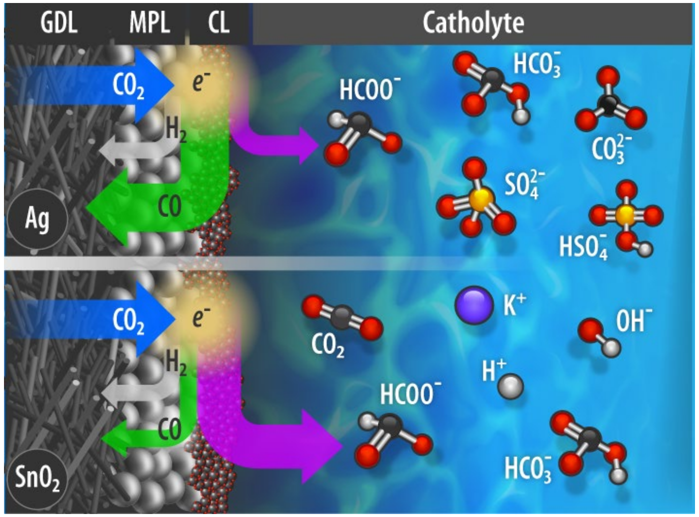


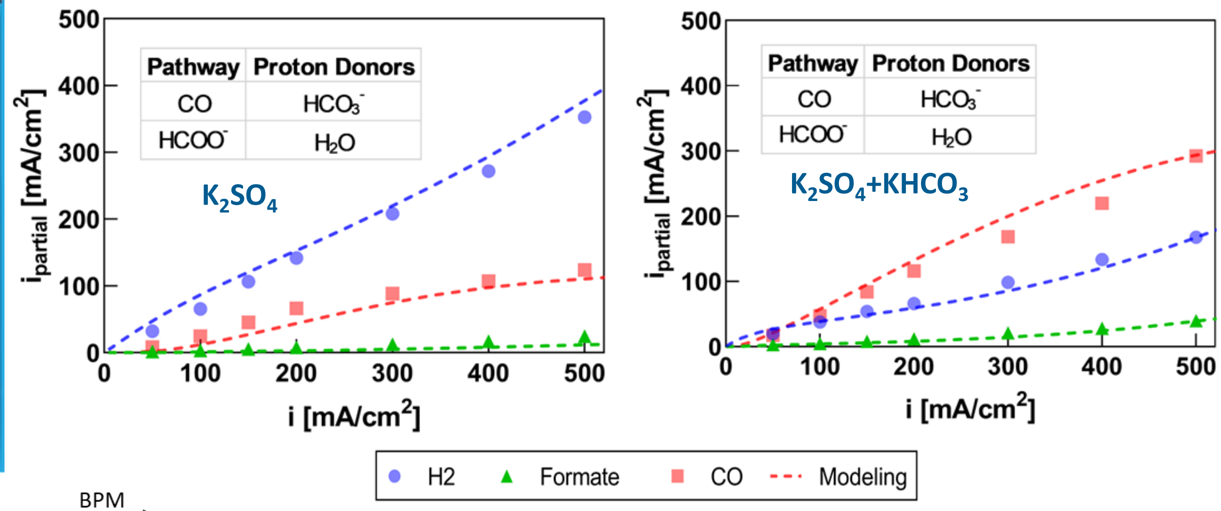


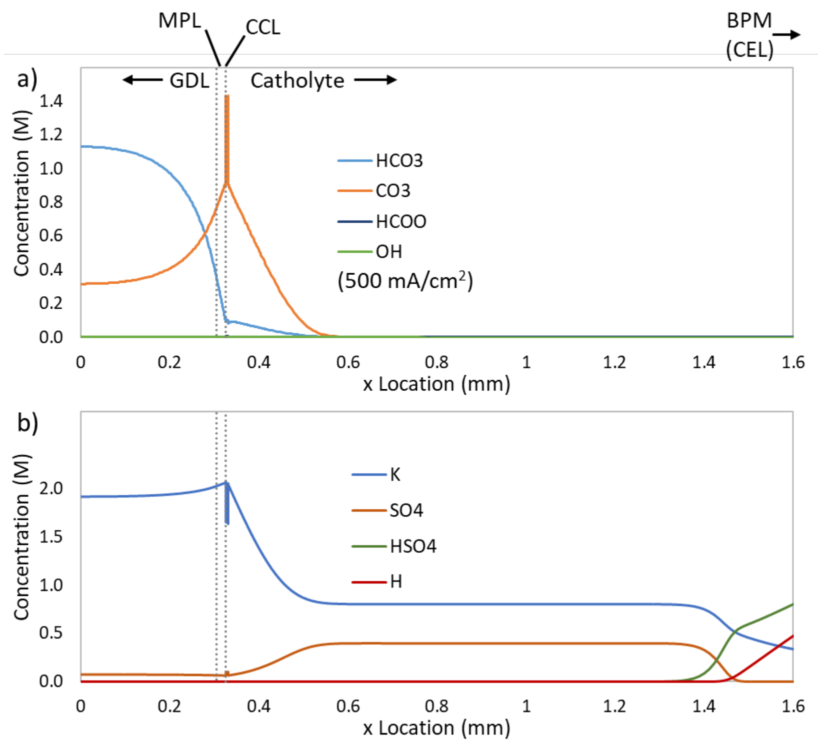
- 90% faradaic efficiency for formate at 500 mA/cm^2
- Achieving new record among the literature making formate with SnO_2 in the aspect of:
  - Max partial current density
  - Electrode active area

ACS Energy Letters, 5, 1825-1833, 2020.

Electrode Development & System Design for CO_2 Electrolyzer





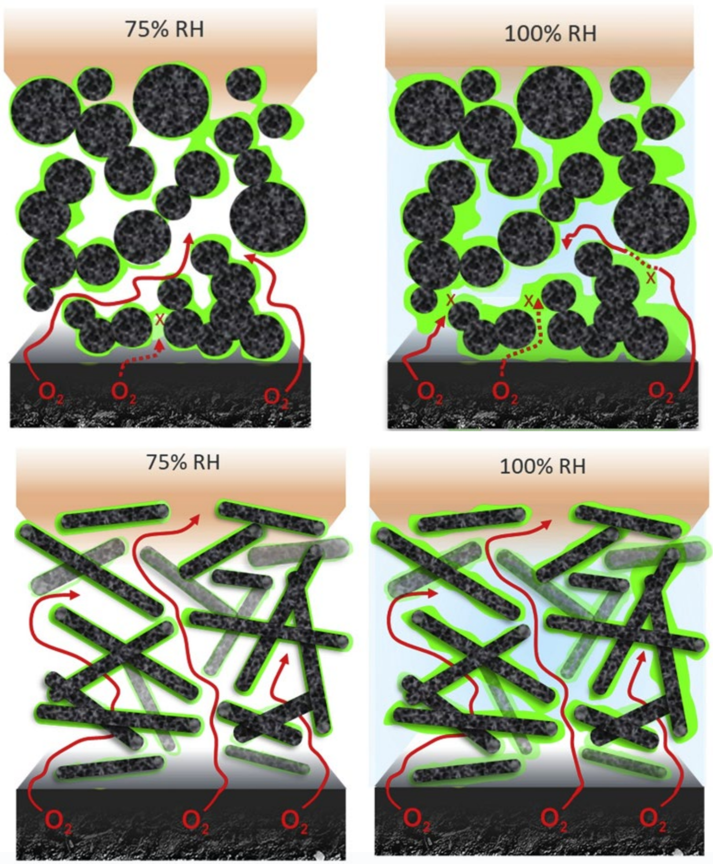


- The combination of experimental and modeling work identifies the proton donors for each CO2R pathway, and explains the factors affecting the reaction efficiencies.
- The modeling of the species concentrations gives guidance for further system optimization

**Manuscript in preparation*

Future Work

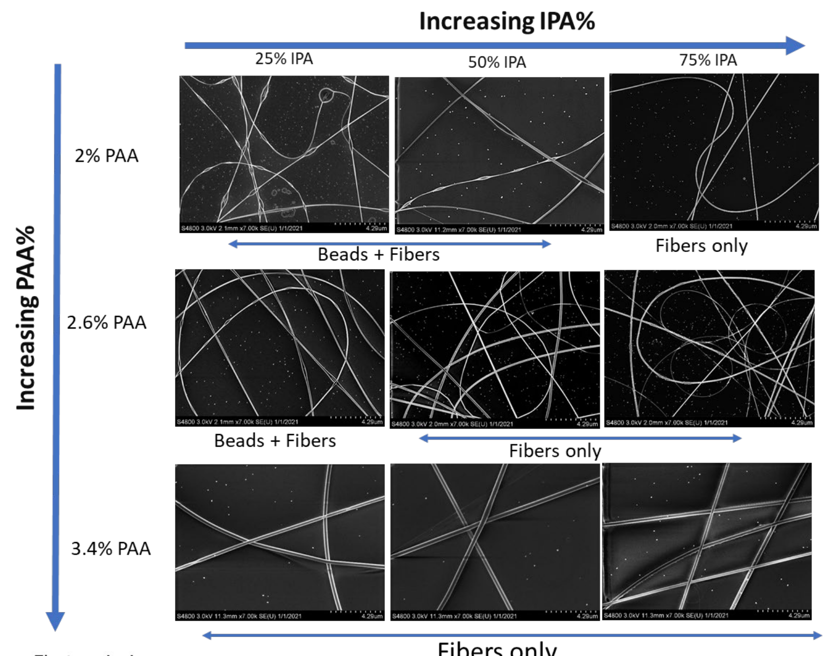
Why Espun Catalyst Layer?

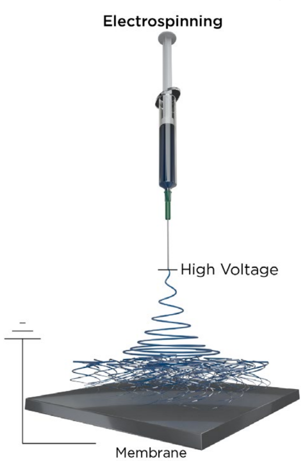


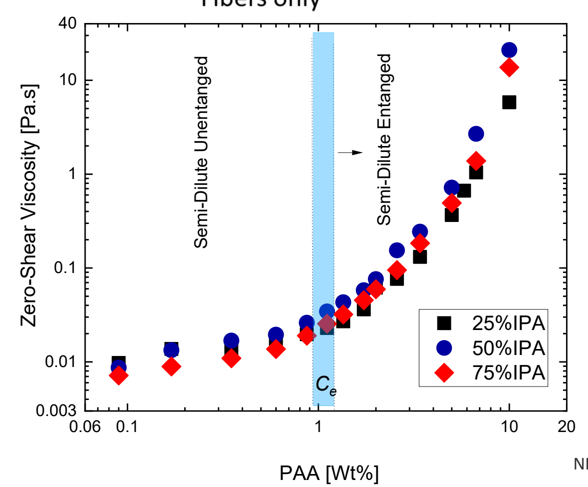
- Increased inter-fiber porosity limits effect of ionomer swelling at high RH
- Break-up of catalyst aggregates due to particle shearing, improves gas reactant access to electrochemical active sites

**Nano Energy 2020, 73, 104791.*

Ink Structure Rheology vs. Spinnability and Fiber Morphology







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NREL Transforming ENERGY

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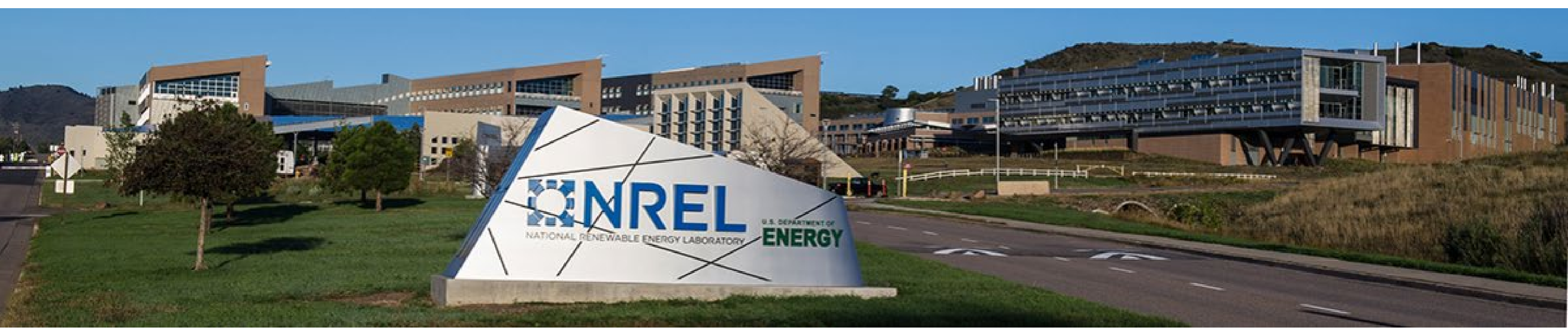


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THANK YOU