Efficient Electrocatalysts Achieving High Current Densities For A Water Splitting Electrolyzer System

ACT-H2
HYDROGEN RESEARCH

Asim Riaz[1], Chennupati Jagadish[2], Hoe Tan[2], Siva Karuturi[1]

Background

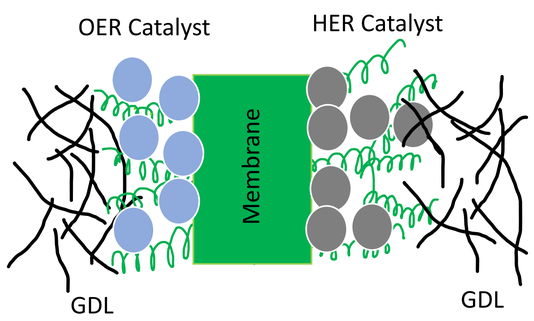
Anion exchange membrane water electrolyser (AEM-WE) system is a favourable choice for hydrogen production because it utilizes low-cost and earth abundant catalyst electrodes when compared to proton exchange membrane electrolysers (PEM-WE) comprising precious metal electrodes.

Conventional membrane-electrode assembly (MEA) in an electrolyser is a membrane, thick coated with oxygen evolution catalyst (OER) on one side and hydrogen evolution catalyst (HER) coated on other side, sandwiched between gas diffusion layers (GDL). This results in a less stable system resulted by catalyst erosion and catalyst instability in harsh alkaline environments.

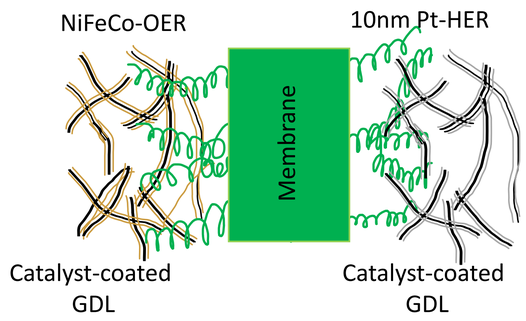
Thin films of porous nanostructures on porous substrates are advantageous because:

- Enhance the electrochemical surface area
- Deliver high current densities at low operating potentials
- More stable than thick films
- Membrane can be re-used
- Efficient gas diffusion
- Less catalyst material required

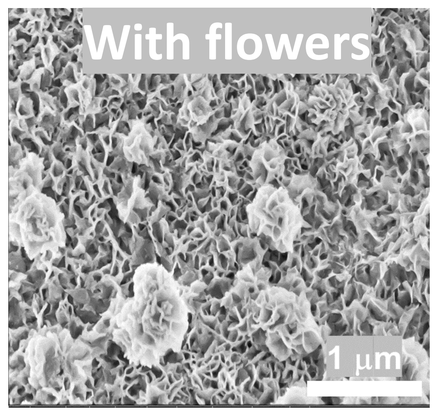
Conventional MEA

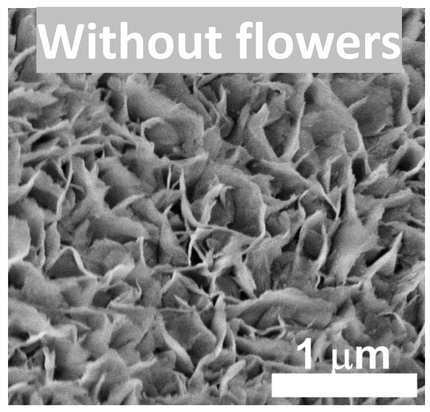


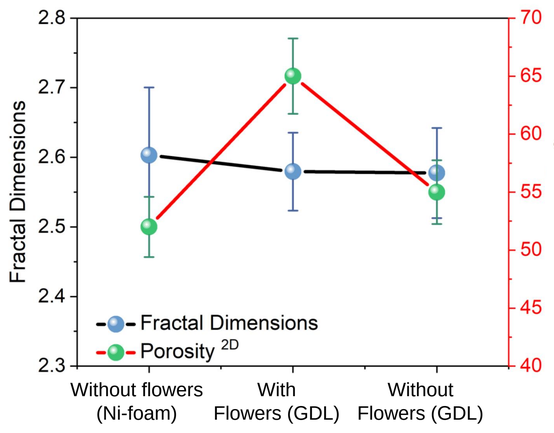
Modified MEA

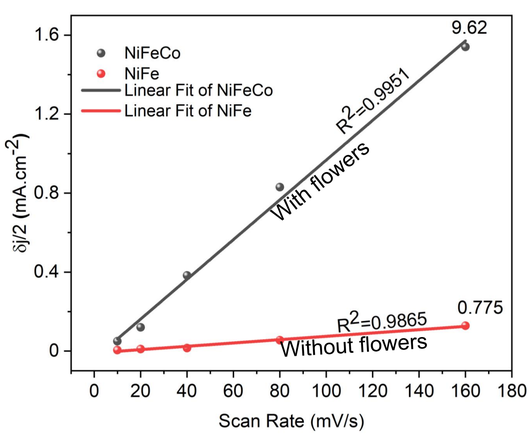


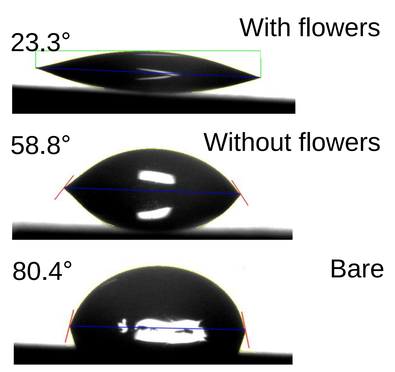
Structural Study



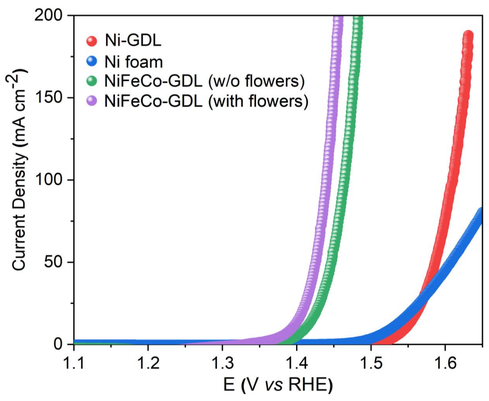


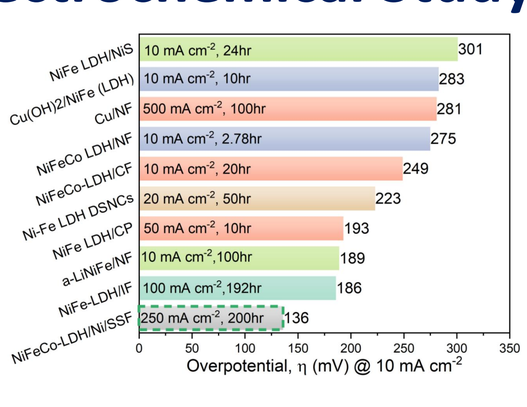


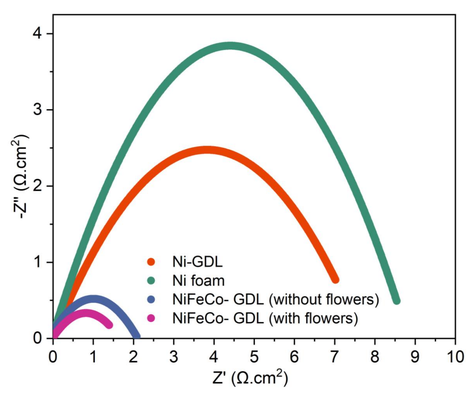


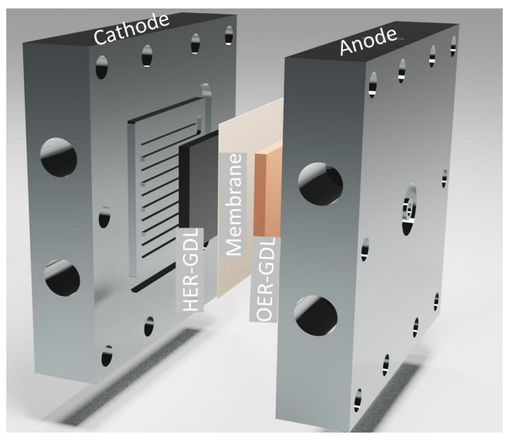


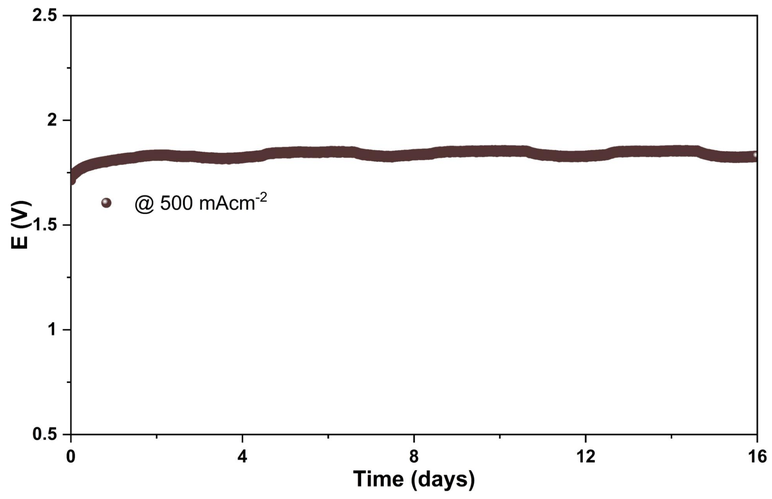
Electrochemical Study











Conclusion

Key takeaway:

- Nanostructured coatings are more efficient than bulk coatings.
- Increase in porosity enhances the electrochemically active area for catalysis.
- Thin film catalyst coating on GDL are more cost effective and enhance the stability, when compared to catalyst-coated membranes.

Acknowledgements

We acknowledge the funding support by the Australian Government through the Australian Renewable Energy Agency (ARENA) and the Australian Research Council (ARC). The authors also acknowledge the use of facilities, technical support, and contribution from the ACT Node of the Australian National Fabrication Facility.

Further Information

This work has been submitted for publication

asim.riaz@anu.edu.au
siva.karuturi@anu.edu.au

Australian National University

[1]School of Engineering
[2]School of Physics
The Australian National University, Canberra ACT 2601, Australia