MSc thesis topic: Catalyst Regeneration for Seawater Electrolysis

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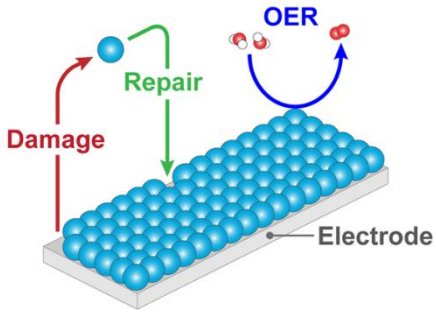
To accelerate the energy transition, the conversion of renewable energy in fuels and chemicals is indispensable. Green hydrogen is rapidly gaining interest as sustainable fuel, or can be used as precursor for chemical processes. For the production of green hydrogen, large water electrolyzers are envisioned for offshore or near shore, to ease the connection to wind energy and/or floating solar. However, conventional electrolysis requires a substantial amount of water at extremely high purity. The combination of water use in electrolysis and the huge seawater availability has created the idea to develop a seawater electrolyzer.



Initial tests for seawater electrolysis have been performed, and main challenges have been identified. One of the challenges in seawater electrolysis is the corrosion of anode due to Cl^- attack and the change in local pH. In this MSc thesis project, you will develop anode catalyst regeneration by switching potential bias. By the switching potential bias, the catalyst is redeposited to the anode and the lifetime of the seawater electrolyzer is increased. You will investigate the change of electrochemical active surface area and the morphology of catalyst when feeding seawater to an electrolysis unit and after regeneration. The work will be focused on experiments, complemented with estimations from theory.

Your activities will be:

- Constructing a water electrolysis cell to monitor the electrode condition;
- Modifying the composition of the catalyst for the investigation on regeneration;
- Conducting high-tech electrochemical analysis (voltammograms, impedance spectroscopy, high-speed current interrupts) and electrode analysis (microscopy, X-ray techniques);
- Combining results to better understand and control regeneration process for stable seawater electrolysis

We are looking for: M.Sc. student Chemical Engineering, Mechanical Engineering, Environmental Engineering or Sustainable Energy Technology, with interest in innovation, electrochemistry, experimenting and hydrogen. Good teamwork is expected, as this work is a part of a cross-discipline collaboration project.

What's in it for you?: Working on this topic will make you ready for industry/academia job by

- Combining multiple disciplines into a practical technology analysis;
- Working on improving existing renewable energy technologies;
- Experience with state-of-the-art electrochemical techniques;
- Working together in a large team of electrochemical engineers and researchers.

For more information, please contact: Ai-Yu Liou (A.Liou@tudelft.nl)

Reference: Thorarinsdottir, Agnes E., Samuel S. Veroneau, and Daniel G. Nocera. "Self-healing oxygen evolution catalysts." *Nature Communications* 13.1 (2022): 1243.