Advanced Manufacturing Alkaline Electrolyser Cell-Stacks for Affordable and Scalable Green Hydrogen Production

Antonio Tricoli, Drew Evans, Rosalie K. Hocking, Alexandr N. Simonov, Fengwang Li, Bryn Jones, Gerry Swiegers

University of Sydney, University of South Australia, Swinburne University of Technology, Monash University, entX, Hysata

antonio.tricoli@sydney.edu.au

Project Aim and Overview

This project aims to decrease the cost and improve the scalability and efficiency of alkaline electrolysis, establishing it as an affordable and commercially viable technology for green H_2 production at a global scale. Specific sub-aims are:

- ❑ Optimise the composition of flame-made iron-based electrocatalysts for efficient and stable alkaline water splitting with a thermoneutral efficiency > 80%
- ❑ Integrate the anode, cathode, and separator into an innovative anode-cathode assembly (ACA) design to decrease the cell-stack cost by > 50%
- ❑ Optimise the ACA & cell-stack fabrication technology
- ❑ Scale-up and commercialise the resulting roll-to-roll ACA fabrication technology for alkaline electrolysers

Technology

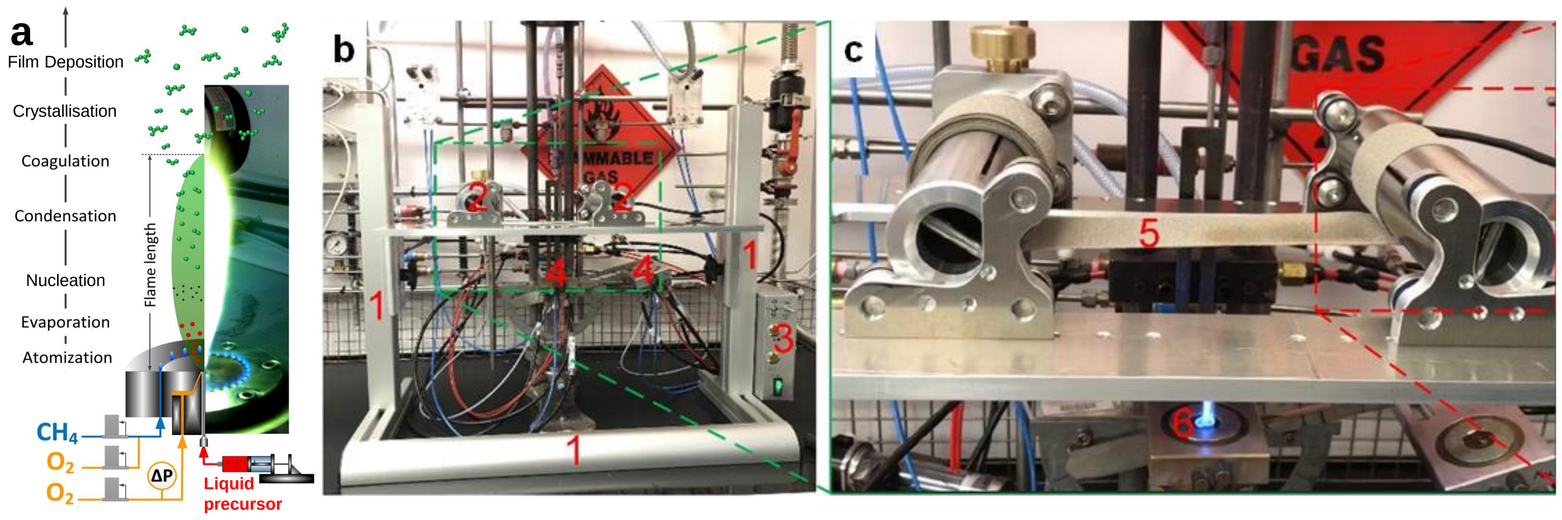
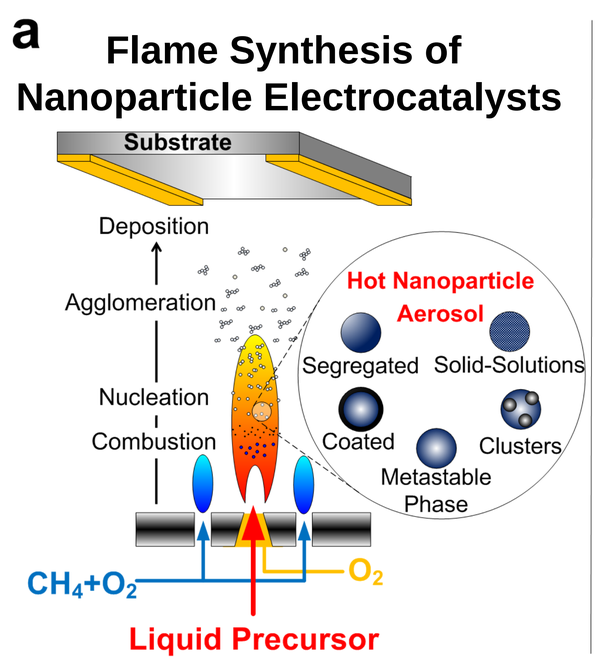


Figure 1. *a) Schematic of the flame-synthesis process and (b,c) photographs of the roll-to-roll flame reactor for the synthesis and direct deposition of the electrocatalysts on the anodes and cathodes.*

Methods and Expected Results



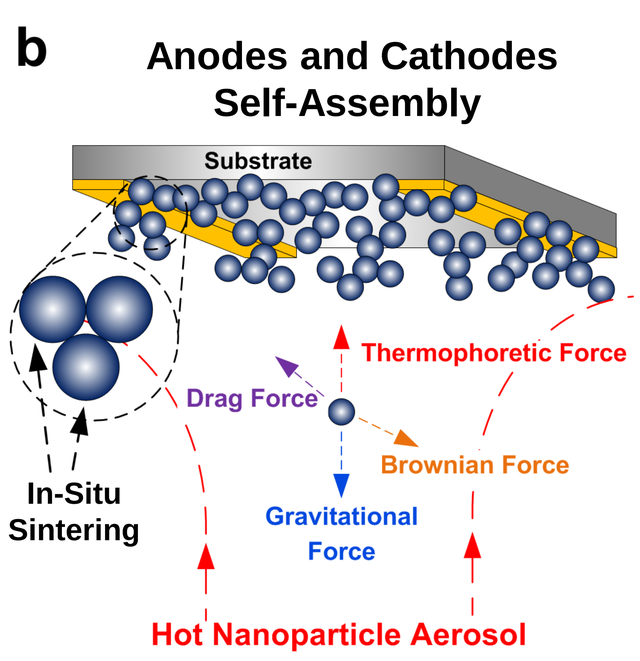
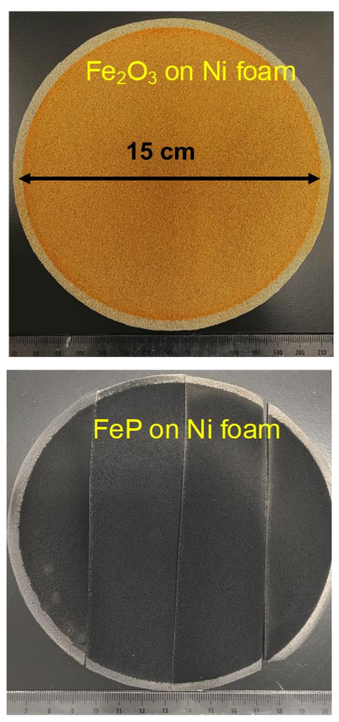


Figure 2. *a) Design of porous multi-metallic phosphides anodes and cathodes by flame synthesis of tailored electrocatalyst nanoparticle aerosols and (b) continuous aerosol self-assembly of nanostructured films on large substrates with well controlled porosity, composition and loading/thickness for the oxygen (OER) and hydrogen evolution reactions (HER).*



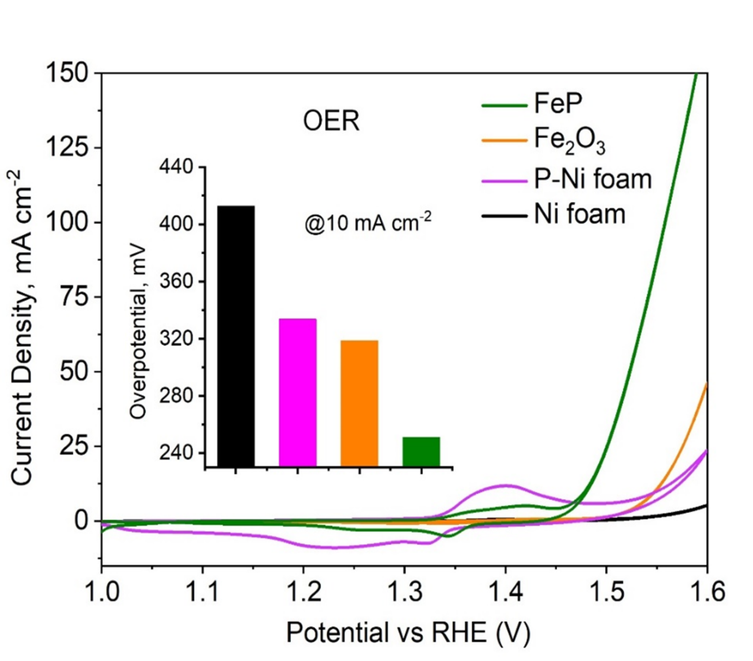
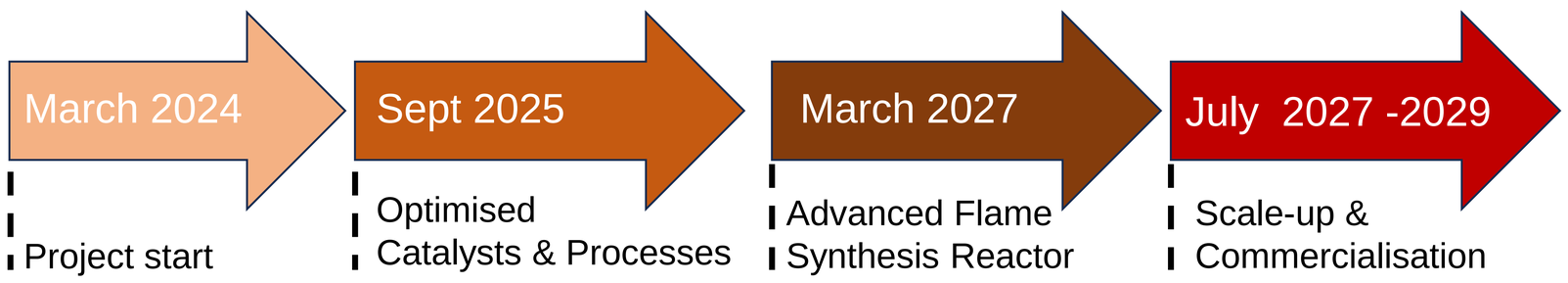


Figure 3. *Preliminary results. Optical images of flame-made electrocatalyst layers on the porous nickel foam substrates used for the anodes and cathodes. OER Performance of the electrocatalyst-loaded foams and comparison samples showing excellent activity.*

Envisioned Outcomes

- ❑ Accelerated commercialisation of renewable hydrogen through innovative Research and Development in alkaline electrolysis technologies
- ❑ Increased academic research capacity in the Australian hydrogen sector, and the facilitation of collaboration between research groups & industry
- ❑ Improvement in the technology readiness and commercial readiness of the resulting alkaline electrolyser fabrication technology
- ❑ Roll-to-roll manufacturing of earth abundant catalysts with integrated separator to enable large-scale fabrication of alkaline electrolyser cells
- ❑ A scalable and low-cost technology for fabrication of earth abundant, low-cost, efficient and durable alkaline electrolyser catalysts and electrodes
- ❑ A pathway to scaling-up & commercialising this alkaline electrolyser fabrication technology to reduce the costs of green hydrogen production

Timeline



Next Steps

- ❑ Recruitment of project PhD students, research fellows and research assistants
- ❑ Project commencement meeting
- ❑ Design and assembly of USYD membrane-free alkaline electrolyser
- ❑ Optimisation of the roll-to-roll flame setup with entX
- ❑ Engineering of electrocatalysts with test & benchmarking at Hysata

This Project received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Transformative Research Accelerating Commercialisation Program