

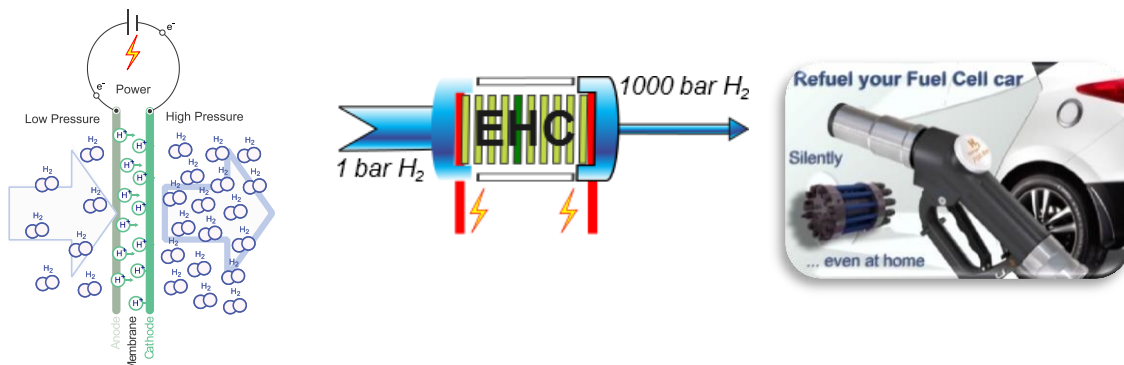
MSc graduation assignment

Project: Proton exchange membrane development for EHC: polymer chemistry and thin film casting

1 Introduction

HyET Hydrogen B.V. in Arnhem, The Netherlands is a growing high tech start-up company developing and producing **electrochemical hydrogen purification and compression technology**. Recently **HyET Hydrogen USA was founded**. H_2 is an energy carrier used for **solar and wind energy storage** and **fuel cell powered vehicles**. H_2 is also produced and converted at large scale in refineries and the chemical/process industry. All these applications require high purity and pressurised hydrogen that can be obtained using HyET's quiet energy efficient and cost-effective processing technology.

The working principle is based on 1) a voltage driven electrochemical oxidation of hydrogen to protons,



2) subsequent migration of these protons through an electrically insulating and gas impermeable polymer membrane and 3) final re-combination of these protons with electrons to re-produce high purity/pressure molecular hydrogen. This process is selective for hydrogen allowing hydrogen purification. The EHC cell very much resembles PEM fuel cells structure, incorporating electrocatalyst layers sandwiching a proton conducting polymer membrane.

HyET has opportunities for students looking for a dynamic and challenging high tech working environment where technological goals are achieved by autonomous co-workers collaborating in an interdisciplinary team of H_2 enthusiasts. Students in chemistry, chemical/mechanical engineering and system control & software engineering have successfully completed their internship or graduation assignment at HyET. Are you next?

2 Assignment

Project goal: Sulfonated polymer development, appropriate cross link chemistry and thin film casting

Project description: HyET has found a proton conducting polymer with very high proton conductivity that is promising for application in electrochemical compressor cells. However, as a membrane the material lacks the mechanical stability for high pressure use. Therefore, Lawrence Berkeley National Laboratory will develop a cost effective synthesis route ready for scale up, the proper chemistry for mechanical property improvement and the membrane casting process. HyET will test the resulting membrane materials in EHC cells on conductivity and pressurization performance. In a joint effort LBNL and HyET will assess the supply chain for the new polymer and membrane finding US suppliers for polymer and thin films. The MSc graduation assignment is closely linked to these project goals. The MSc student will work at the LBNL facilities.

3 Additional information

HyET Hydrogen USA offers:

- Minimum 6 (preferably 9) month project assignment as described above at the Lawrence Berkeley National Laboratory in the USA.
- Housing (HyET House) in Berkeley, California, USA.
- € 750 / month internship fee.
- The opportunity of becoming an HyET Hydrogen employee after graduation

Required student expertise:	Date: 23-Feb-18
Polymer chemistry	For further information please contact:
Chemical Engineering	martijn.mulder@hyet.nl
Electrochemistry	or check our website http://hyet.nl/hydrogen/
	Document number: 20180223MScAssignmentMEMTECH

Student profile / requirements:

Solid organic, synthetic chemistry background, preferably in polymer chemistry and experience with sulfonate chemistry is an advantage.