

INTRODUCTION

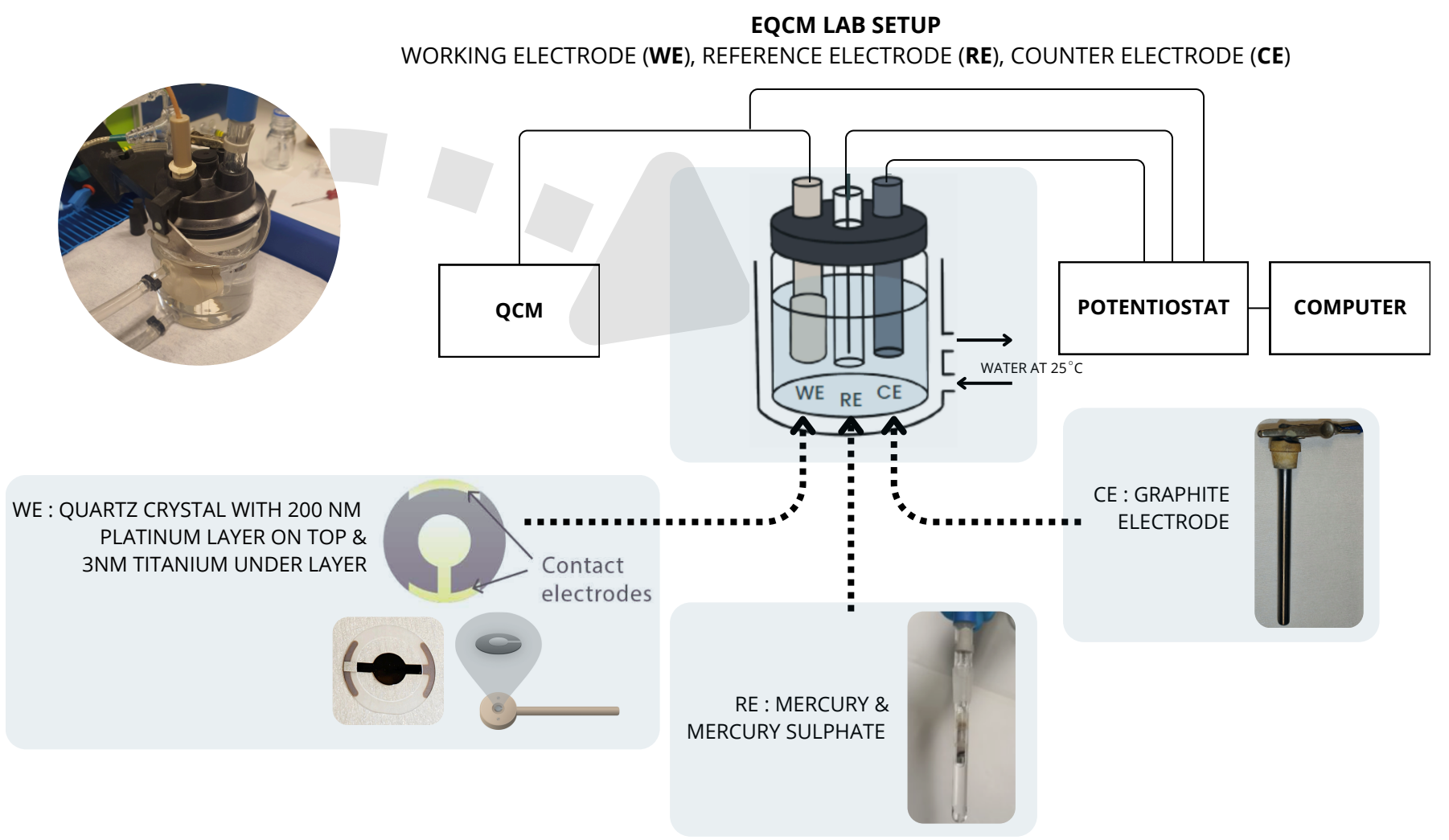
During recent years the incentive for sustainable solutions in the energy sector have increased and as a consequence so has the interest for fuel cells. The most commonly used fuel cell is the proton exchange fuel cell (PEMFC) which uses an expensive platinum catalyst. The working environment for the fuel cell is acidic causing the platinum catalyst to degrade over time. To make PEMFC more commercially viable it is important to get more knowledge regarding how and when the platinum starts degrading.

SCOPE

The aim of the project is to study the degradation of platinum in a similar environment as in a fuel cell. By utilizing quartz crystal microbalance (EQCM) and cyclic voltammetry (CV) the mass change and performance of the platinum will be investigated during a variety of upper potentials limits (UPL) ranging from 0.9 to 1.5V.

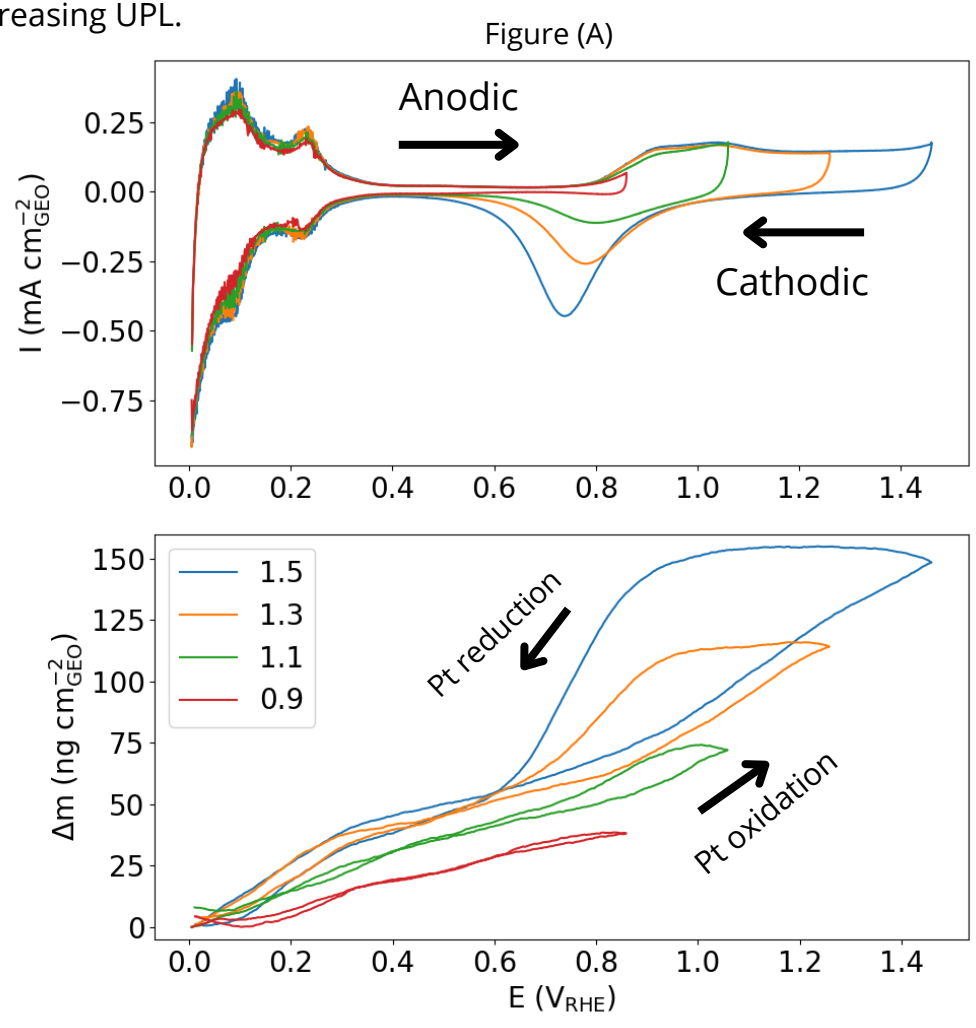
METHODOLOGY

The experiment was conducted by placing the three electrodes in a 0.5M sulphuric acid electrolyte solution and by connecting these to the potentiostat. The upper electrode of the QCM was at the same time used as a working electrode in the electrochemical measurements. Since the reference electrode has another standard potential value than reversible hydrogen electrode (RHE) this had to be accounted for. The QCM and the CV measurements were recorded at a synchronized time. In the experiment four different switching potentials were used and after each CV was completed the voltage was held constant to facilitate the processing of the data.



RESULTS & DISCUSSION

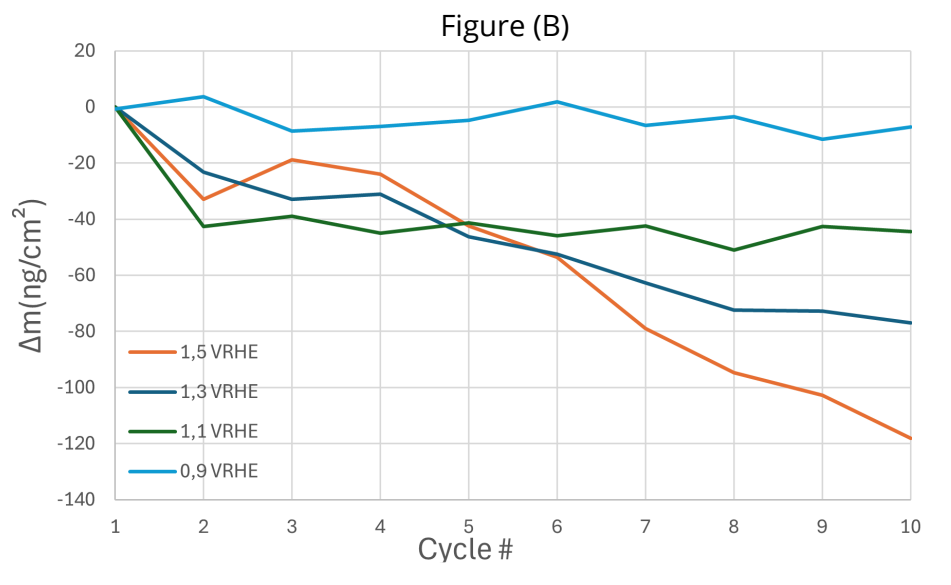
During anodic sweeps mass is gained due to Pt-O and Pt-OH adsorption and during cathodic sweeps Pt reduces back to its metal state and some mass is lost to the electrolyte. The mass change was calculated by converting the frequency change using equation 1. The mass change is the lowest and the most stable at 0.9V and increases with increasing UPL.



$$\Delta m = -\Delta f \frac{\sqrt{\rho_q \mu_q}}{2nf_0^2}$$

[1] Sauerbrey equation

UPL	Avg Δm/cycle
1.5	-12.1
1.3	-7.7
1.1	-3.9
0.9	-0.72



MAIN TAKE AWAYS

- Increased mass loss was observed at higher UPL, indicating enhanced catalyst degradation.
- Minimal change in mass was detected at 0.9V which suggests stable performance, while 1.5V causes significant degradation of the catalyst.
- Higher UPL promotes thicker Pt oxide layer during oxidation, which leads to some Pt dissolution into electrolyte during reduction rather than full re-deposition.
- These results offer fundamental insights into catalyst stability under varying potentials.

[1]. Kankare, J. (2002). Sauerbrey Equation of Quartz Crystal Microbalance in Liquid medium. Langmuir, 18(18), 7092-7094. <https://doi.org/10.1021/la025911w>