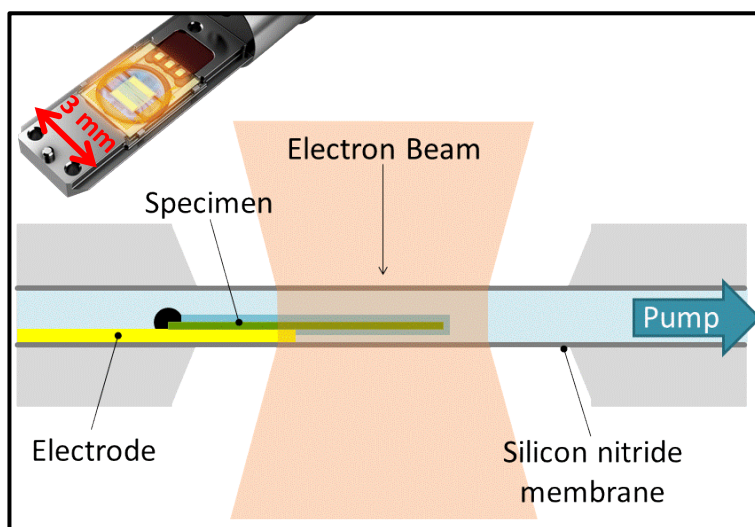


## Commissioning a Micro-Fluid Electrochemical Reactor Cell

Observing the dynamics at surfaces during electro-chemical reactions such as water splitting or lithiation is of tremendous importance for understanding the basic mechanisms of energy conversion. Such studies can be performed using an electrochemical liquid cell in a Transmission Electron Microscope (TEM). Due to the limited space in the TEM as well as requiring that the liquid layer is transparent to the electron beam (less than one micrometer in thickness, see Figure), the liquid cell must be very small. Controlling the liquid flows in the micrometer scale channels of such a cell is an important step that demands a deep understanding of microfluidics and wetting behavior.

We are purchasing an electrochemical liquid cell, with associated TEM holder and optical microscope holder from the company Protochips (see Figure). This holder will be used to study lithiation and water splitting at solid surfaces inside the TEM. It will first be commissioned using optical imaging before it is inserted in the TEM.



*Schematic cross-section showing the electron beam passing through the reactor cell. Imaging will first be performed with optical light instead of electrons. (Inset) Electrochemical liquid cell mounted in a specially designed TEM holder from the company Protochips.*

### Work Plan:

The electrochemical liquid cell will first be mounted in the optical microscope holder where optical imaging will be used to observe the operating cell. Optimizations of the fluid flow will be performed using a syringe pump to inject the electrolyte and a membrane pump to reduce the pressure to reach the two phase liquid-gas regime. The goal is to develop a method that will keep the specimen covered in liquid at all times, avoid bowing of the silicon nitride membrane, and minimize trapping of air bubbles.

### Experimental Methods:

The liquid cell and the optical holder will be used independently by the student in combination with a high resolution optical microscope. Transmission Electron Microscopy (TEM), which may be needed later in the project, will be performed together with members of the Working Group.

**The Master Thesis may be written in either English or German.**

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