Group: Advanced Materials for Chemical Sensitivity (AMCS)
Project: **Electro-driven, Ion-selective Removal**
Supervisors: Sevil Sahin, Louis de Smet

Introduction

Electro-driven desalination processes, which currently largely focus on purifying water, have also the potential to obtain salts at high purity. For instance, lithium, which is increasingly used to fabricate Li-ion batteries, is largely drawn from salt-lake brines, but the presence of interfering ions like Na^+ and K^+ reduces the purity. Also, phosphate, which is a high-value, non-renewable natural resource, is currently mainly recovered from waste streams using precipitation methods that require chemicals and lack selectively. High purities could be obtained when combing electro-driven separation with ion-selective properties.

Goal

In this research program we make use of capacitive deionization (CDI), a technique that makes use of porous electrodes, which can be loaded with ions using an electrical field (Figure 1, left). Currently, CDI can only discriminate between the type of charge (anion *versus* cation), but the addition of ion-selective membranes would enable one to recover/harvest specific ions from (waste) water.

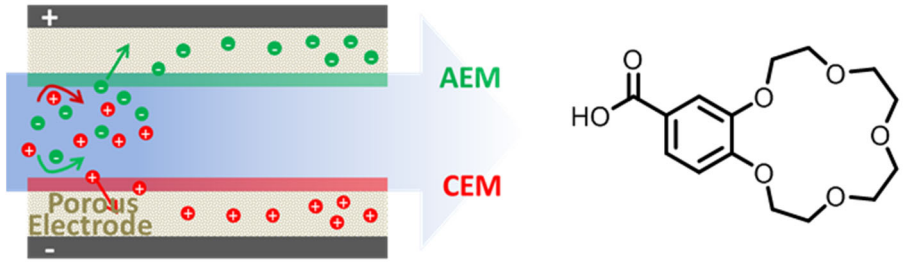

Figure 1. Left: Schematic representation of capacitive deionization with anion and cation-exchange membranes (AEM and CEM, respectively). Right: The structure of an Na^+-selective molecule that will be used to functionalize the porous electrodes.

We explore the use of electro-driven separations to achieve targeted (ion-selective) removal. Our current focus is on the preparation of ultrathin coatings of alternating layers of oppositely charged polymers (polyelectrolytes). The integration of ion-selective materials, like the one shown in Figure 1, may further tune the selectivity.

Techniques to be used

This will largely depend on main focus of the research within this theme. Synthesis (+ NMR, UV-Vis, IR), surface modification (XPS, AFM), electrochemical techniques and analytical techniques to study the salt composition of aqueous solutions (*e.g.*, ion chromatography and ion-coupled plasma, in collaboration with Environmental Technology, Dr Dykstra). Modelling of electrical double layers can also be performed in strong collaboration with Kaustub Singh and Wetsus (Dr. Biesheuvel).

Contact

Sevil Sahin, sevil.sahin@wur.nl, 0317-482375, Helix 7.037.
Louis de Smet, louis.desmet@wur.nl, 0317– 481268 / 82361, Helix 7.034.