MSc thesis topic: Asymmetric porous anion exchange membranes made from functionalized Polyhenyleneoxide using non solvent induced phase separation (NIPS)

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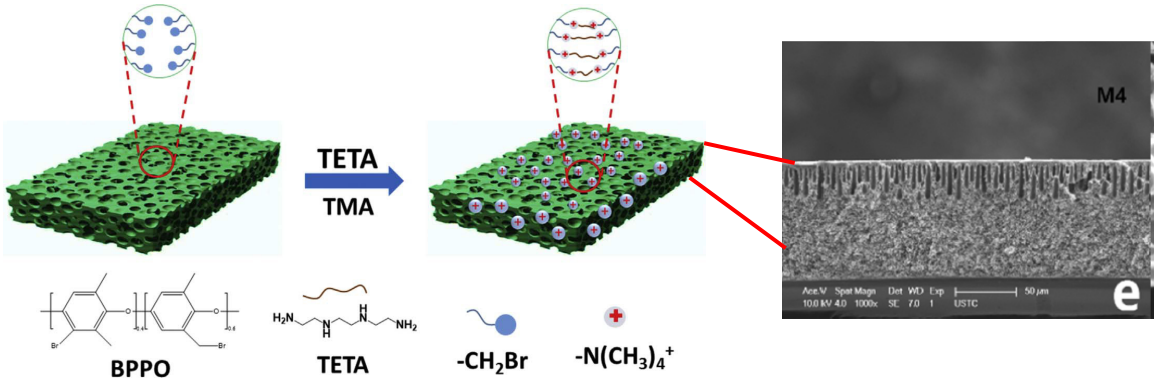

Anion-exchange membranes play an important role in electrochemical applications such as CO_2 electrolysis or alkaline fuel cells. However, there is a trade-off between selectivity and conductivity of currently commercially available membranes which is limiting the performance. For example, membranes are made from imidazolium-polyphenyleneoxide (Im-PPO) in a dense layer. We explore in our group whether other membrane types give better performance for converting water and CO_2 into chemicals using renewable energy. Multilayer membranes are a new approach to enable high ion selectivity while simultaneously exceeding state-of-the-art ion conductivity.

The goal of this thesis is to cast brominated PPO (BrPPO) and immerse the resulting liquid polymer film in a isopropanol/water mixture, resulting in a membrane with a porous structure which can then be functionalized further. This process is called non-solvent induced phase inversion (NIPS) and has been studied extensively in literature. There is, however, a research gap when it comes to the electrochemical properties of such porous membranes. We are particularly interested in whether these membranes could offer a way to break the selectivity/conductivity trade-off of conventional dense anion-exchange membranes and how the porous membranes can be further modified to help achieve this goal.

Your activities will be:

- Fabricate porous PPO membranes using NIPS, varying the composition of the immersion liquid.
- Characterizing these membranes using various methods like SEM, EDX and by doing electrochemical measurements to determine conductivity and selectivity.
- Applying improved membranes in electrochemical cells

We are looking for: M.Sc. Chemical Engineering students with an interest in innovation, electrochemistry, polymer chemistry and a willingness to perform experiments.

What is in it for you?: Working on this topic will teach you:

- How to think analytically and work with electrochemical systems;
- How to plan experiments and apply the results to electrochemical applications;
- Contribute to making electrochemical energy conversion more efficient

For more information please contact Max Seling (M.S.Seling@tudelft.nl)

References:

(1) Liang Ge et al. Advanced charged porous membranes with ultrahigh selectivity and permeability for acid recovery, Journal of Membrane Science, Volume 536, 2017, Pages 11-18; https://doi.org/10.1016/j.memsci.2017.04.055.