MSc Assignment: Fabrication of defect-free high-silica CHA zeolite membranes for gas separation applications

Zeolite membranes are one of the pioneering membrane materials for the separation of gases as they are mechanically, chemically and thermally stable at extreme process conditions and have uniform and molecular-sized pore structures. Chabazite (CHA) type zeolite framework is one of the smallest pore size (0.38 nm) zeolite structures that could be used as membrane material for the separation of gases [1–3] such as N_2/CH_4 and CO_2/CH_4 in natural gas purification.

The main challenge in zeolite membranes to be implemented in large scale chemical industries is the formation of defects during the crystal growth and template removal steps. There are various methods developed such as rapid thermal processing [4], ozonication [5] and ultraviolet irradiation [6] to overcome the defect formation during template removal steps which would also be used as alternative approaches to the conventional calcination treatment.

In this project, the CHA seed crystals will be produced, attached on porous supports and growth into a continuous zeolite layer as shown in Figure 1. By the control of the synthesis parameters and optimization of the fabrication technique, the defect formation will be eliminated which eventually bring us high gas separation performances.

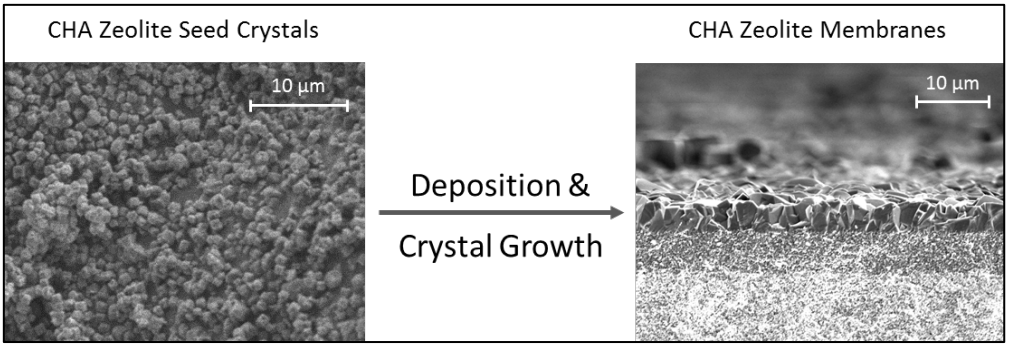

Figure 1: The SEM images of the CHA seed crystals (on the left) which are further deposited on a porous support and grown into a continuous zeolite membrane layer

The master student will benefit from the knowledge and expertise of the Inorganic membranes group for:

1. **Synthesis** of high-silica CHA seed crystals and their growth into zeolite membranes
2. **Characterization of the synthesized materials** by various techniques such as X-Ray Diffraction (XRD), X-Ray Fluorescence(XRF), thermogravimetric analysis (TGA), confocal microscopy, scanning electron microscopy (SEM), N_2 adsorption/desorption
3. **Evaluation of the performance** of the membranes in single gas permeation and mixed gas separation.

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