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|  |  |  הטכניון - מכון טכנולוגי לישראל TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY  |
| הפקולטה להנדסה כימיתע"ש וולפסון |  |  |
| The Wolfson Department of Chemical Engineering |  |  |

**Wolfson Department of Chemical Engineering Seminar**

**Wolfson Department of Chemical Engineering, Lecture Hall No. 6**

**Wednesday, August 11th, 2021 at 13:30**

**Development of a predictive kinetic model with statistically analyzed parameters for Donnan dialysis process**

**Yunyan Huang**

Department of Chemical Engineering, Technion-Israel Institute for Technology

**MSc Seminar**

Advisor: Prof. Raphael Semiat

Co-Advisor: Prof. Slava Freger

Donnan Dialysis (DD) utilizes ion exchange membranes that allow a selective transport of target ions from a feed solution to a concentrated receiver solution. This technology is attractive for its significant advantages of low energy consumption and simple operation. The overall rate of DD mass transfer is determined by the sum of two resistances: a resistance related to the ion diffusion through the membrane and a resistance related to the mass transfer from the bulk solution to the membrane interface. The kinetics of the system can be conveniently divided into three transport mechanism regimes: pure boundary layer diffusion, pure diffusional membrane transport and a mixed regime where both mechanisms are effective.

The objective of the research is to develop an automated computational model that can predict the target ions concentration profile and transport mechanism of the DD process. Experiments were conducted at various operating parameters, and a statistical approach was used to determine the effect of these parameters on the DD transport.

Two models, previously developed in the Rabin Desalination Laboratory- a model describing transport under boundary layer diffusion control and a model describing transport under membrane diffusion control were used to extract the kinetics coefficients at various operating conditions. Statistical analysis of the kinetics coefficients revealed that Reynolds number and the solution composition are the only significant operating parameters that affect the DD transport. Next, trained correlations between the influential operating parameters and the kinetic coefficients were found with 95% confidence. A model which includes the transport mechanisms and the trained correlations was developed and solved numerically. Full verification of the predictions of the model, for both concentration profile and transport mechanism, was obtained from multiple experimental data.

**Refreshments will be served at 13:15**

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**Zoom link:** <https://technion.zoom.us/j/98982676170>

**Mixed matrix membrane (MMM) made of interstitially sealed dense layers of MOF nanoparticles**

**Ruiying Li**

Department of Chemical Engineering, Technion-Israel Institute for Technology & GTIIT

**MSc Seminar**

Advisor: Prof. Paul Chen; Prof. Slava Freger

Metal organic frameworks (MOFs) consisting of metal ions/cluster and organic ligands emerges as a new class of porous coordination polymers in recent decades. This hybrid material shows attractive properties such as ultrahigh porosity, large internal surface area, well-defined and tunable pore size as well as great structural variability, making MOFs potentially attractive for various applications. However, the synthesis of MOFs usually yields a powder form, which is hard to be implemented in industrial applications, especially, in water treatment and solvent separation. Thus, to get over the drawback, mixing MOFs with polymer to fabricate MOF mixed matrix membrane (MOF MMM) can be used. While utilizing the superior separation performance of MOFs, it also adds the benefits of robustness and flexibility of polymers. Recently, this approach has been intensively studied and shows promising results in the fabrication and applications of MOF MMM.

The typical method to fabricate MOF MMM is to first mix MOF nanoparticles with polymer and then cast the suspension as a coating on a substrate. Yet, there still exist challenges for MMM: (1) MOF loading is low due to insufficient stirring and particle agglomeration, causing the less satisfactory membrane performance; (2) The coating process dictates that the thickness of the coating layer be much larger than the diameter of MOF particles, and consequently the permselectivity of the MMM is strongly dependent on the non-selective polymer matrix instead of the selective MOFs.

Herein, we propose a new facile approach to fabricate MOF MMM using a procedure based on deposition of MOF particles on a porous substrate by filtration and form densely pack layers, simultaneously with or followed by filtration and in situ polymerization of an acrylic monomer that fills and seal the interstitial space between MOF particles. This approach was demonstrated using ZIF-8 as a model MOF and acrylic monomers, hydrophobic butyl methacrylate (BMA) and mildly hydrophilic glycidyl methacrylate (GMA). Several polymerization parameters such as induction time of polymerization, MOFs/ monomer concentrations, pressure and filtration time were varied for optimizing the procedure. FTIR, PXRD, SEM and EDX techniques were used to characterize the MOF MMM. The SEM images show densely packed MOF layers sealed with polymers; EDX results show more than 50% MOF loading. The membrane performance was tested for dye rejection, and the results show that ZIF-8 BMA MMM with denser structure can reject more than 95% dyes. With the addition of ZIF-8, both the dye rejection and permeability (25-fold increase) of membrane were improved.

**Refreshments will be served at 13:15**