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| הפקולטה להנדסה כימיתע"ש וולפסון |  |  |
| The Wolfson Department of Chemical Engineering |  |  |

**Wolfson Department of Chemical Engineering Seminar**

**Wednesday, August 25th, 2021 at 13:30**

**Online seminar via Zoom**

<https://technion.zoom.us/j/98982676170>

**Facile superhydrophobic modification of commercial polyvinylidene fluoride (PVDF) membrane with TiO2 nanoparticles for membrane distillation**

**Zihao Hong**

**MSc Seminar**

Advisor: Prof. Paul Chen

Prof. Raphael Semiat

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

Membrane distillation (MD) is an emerging separation technology combining distillation with the membrane separation process. Different from the conventional membrane processes, the driving force of MD is the vapor pressure difference caused by the temperature gradient on the two sides of membrane. The absence of expensive components, such as high-pressure pumps and pressure exchangers, reduces the capital cost to a certain extent. Furthermore, 100% theoretical rejection of non-volatile components and the capability of utilizing low-grade heat energy render MD the potential for desalination, wastewater treatment, removal of volatile components, etc. However, during the long-term operation, the inevitable wetting and fouling phenomenon could lead to the deteriorated permeate quality and efficiency of MD.

Herein, a modified PVDF membrane was fabricated to migrate the fouling and wetting phenomenon by grafting fluorinated TiO2 nanoparticles onto the substrate. The modification enhanced the roughness and lowered the surface energy, endowing the PVDF membrane with the superhydrophobic property. When immersed into the solution, an interface of solid-vapor-liquid will be formed on the superhydrophobic surface, which minimizes the direct contact between membrane surface and foulants (dissolved organic matters, surfactants, salts, etc.).

The surface chemical construction and surface segregation behavior were characterized and evaluated through contact angle measurements, scanning electron microscopy (SEM), atomic force microscopy (AFM), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared (FTIR) spectroscopy, and direct contact MD (DCMD) test. The maximal water contact angle of the modified membrane was up to 157.4 while the sliding angle was smaller than 5. The hierarchical micro/nano rough structures were observed on the membrane surface via the SEM and AFM images, which were constructed by the distributions of TiO2 nanoparticles. The anti-fouling property of the commercial and modified membrane was investigated by DCMD experiments with feed solution containing NaCl, HA and CaCl2, and the anti-wetting property was tested with feed solutions containing SDS and NaCl. An elevated performance on fouling and wetting resisting was observed from the modified membrane through the relatively stable fluxes and permeate conductivities. Around 10% of flux decline was found in the fouling experiment of modified membrane, while there was almost 40% decrease in the flux of pristine PVDF membrane. For the wetting experiment, the modified membrane’s performance maintained stable throughout the experiment, however, the pristine membrane is totally wetted in a short time.

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**Fe-Mn-Zr Tri-metal Oxide encapsulated in Calcium-alginate (TO-CA) as a magnetic sorbent for Copper Adsorption**

**Baicheng Yuan**

**MSc Seminar**

Advisor: Prof. Paul Chen; Prof. Raphael Semiat

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In light of the demand on the electricity industries, the wastewater from the effluent containing high concentration of heavy metal ions, such as copper, cause a series of health problem. In this study, a kind of adsorbent, the Fe-Mn-Zr tri-metal oxides encapsulated in Calcium alginate (TO-CA) was explored to treat the high concentrated copper contaminants, as it has properties of magnetic property, harmlessness to the environment, and most importantly adsorptive properties for removal of both cationic and anionic contaminants. Calcium alginate is originated from naturally grown algae and was found to have high effectiveness on heavy metal removal. The Fe-Mn-Zr tri-metal oxides microparticles was synthesized by a simple co-precipitation method, resulting in magnetic performance, and the calcium alginate, as a biopolymer, was reported to have good effect on copper removal. The Fe-Mn-Zr tri-metal oxides microparticles can be easily encapsulated by Calcium alginate.

The scanning electron microscopy with energy dispersive X-ray showed that the TO-CA has rough surface with large holes and small pimples on the surface that has element composition of O, Fe, Mn and Zr. The adsorption process was highly pH-dependent, and the optimal adsorption was obtained at pH 5.0. The adsorption isotherm was fitted very well by Langmuir equation and the maximum adsorption capacity was found to be 81.7 mg/g, much higher than most reported adsorbents. The adsorption rapidly occurred in the initial 2 h and then reach equilibrium within 9 h. The existence of sodium, potassium, nitrate, chloride, and sulfate had almost no effect on the copper adsorption, but the ionic strength could decrease the adsorption capacity. The five-cycle experiments showed that the TO-CA could be recycled.

The Fourier transform infrared spectroscopy, the X-ray photoelectron spectroscopy analysis and the ion exchange experiment revealed that the adsorption mechanism of the copper was mainly due to the ion exchange between copper ions in the solution and the calcium ions on the adsorbent surface with slightly ion exchange between solution copper ions and the hydrogen in the carboxyl functional groups of the adsorbent. In conclusion, the magnetic material with method of encapsulation is a kind of prospective adsorbents in the heavy metal adsorption as a part of wastewater treatment.