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| הפקולטה להנדסה כימית  ע"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 4th, 2021 at 13:30**

**Nanomaterial-Based Field Effect Transistors for Detection of Chirality of Volatile Organic Compound**

**Shelley Rapoport**

Department of Chemical Engineering, Technion-Israel Institute for Technology

**MSc Seminar**

Advisor: Professor Hossam Haick

Chiral recognition and separation are currently considered an active area of research due to the potential applications in areas such as chemical synthesis, catalysis, enzyme mimetics, pharmaceutics, geochemistry, and biotechnology. Chiral enantiomers have shown to behave differently in the body or to be the product of a totally different metabolic system in the body being markers of different diseases. Due to the fact that enantiomers have the same physical and chemical characteristics only differing from each other in optical activity, their distinction has always been regarded as one of the most challenging in the field of analytical chemistry.

The methods used in present day are based on a derivative of a column with a stationary chiral selector and mobile chiral selectant. These techniques are, for the most part, expensive, time consuming and difficult to operate and analyze results. The search for a quicker, inexpensive, and easier methods became increasingly important but just as challenging.  
This research presents a novel gas sensor that would be able to detect enantiomers of volatile organic compounds (VOCs). In order to achieve the desired sensitivity, A field effect transistor (FET) was modified using novel Polyaniline (PANI)-Carbon nanotube (CNT) composite. Similar to other chiral recognition methods, chiral PANI was synthesized in a unique helical form with different handedness. The idea was to try and create a steric factor in addition to electrical, since the differences between enantiomers are very slight. Pure CNT-FETs and pure PANI-FETs as gas sensors have been widely investigated but separately presented limitations in stability. Although CNT-FETs can perform as FET, gas sensors, the sensitivity and selectivity are limited. In addition, PANI alone usually do not show FET characteristics which is why combining in a composite can increase the sensor performance greatly.

The helical PANI synthesized was successfully proven to be chiral using circular dichroism (CD). A sensor array was made using five different application methods, CNTs alone, each chiral PANI form alone and with CNTs. Scanning electron microscopy (SEM) analysis was done to assure efficient application of the nanomaterials on the silicon surface of the FET. I-V characteristics were done to ensure that the sensors were working FETs before exposer to the VOCs. The results showed that when the FET is coated with PANI alone, it does not preform like a FET. On the other hand, when combined with the CNTs, the results demonstrated FET behavior.

The array was then exposed to a few VOC groups (i.e., alcohols, aldehydes, Xylene isomers) in addition to the enantiomer VOCs of 1-phenylethanol and Limonene in a range of concentrations. The results showed a different response to each concentration to most of the VOCs and a clear stronger response to sensors when PANI is combined with CNTs rather than CNTs alone. The collective data of the array exposure was then re- analyzed using multi-variant pattern recognition algorithm linear discriminant analysis (DFA) to better visualize the discrimination among sensor types and the different response to the VOCs.

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

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**Wolfson Department of Chemical Engineering Seminar**

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

**Wednesday, August 4th, 2021 at 13:30**

**Stability study of anion exchange membrane for fuel cell**

**Yona Lee**

Department of Chemical Engineering, Technion-Israel Institute for Technology

**Mid-PhD Seminar**

Advisor: Prof. Dario Dekel

Anion exchange membrane (AEM) fuel cells (AEMFCs) have great potential applications for future clean energy converting devices. However, challenges of anion conductivity and especially of limited alkaline stability impede AEMFC’s practical further development towards their commercialization. During AEMFC operation, the hydroxide ions tend to attack the cation functional groups in the AEM, resulting in increased membrane resistance and rapidly degraded cell performance. Therefore, the development of highly stable membranes is one of the major challenges in the AEMFC field.

Crown ethers (CEs) are able to bind specific cationic species because of the ion-dipole interaction of the positively charged ions with the negatively polarized oxygen atoms. Much research has been done on binding crown ethers with metal ions, while very few focused on CE- quaternary ammonium (QA) complex.

In this work, potential stability improvement of AEMs by using crown ethers will be studied. CE will be used as a sterically hindering group, which will shield around the cation functional group (QA), protecting them from OH- attack. First, exploring the potential stabilizing effect of crown ethers on the QAs will be achieved. Then, various AEM synthesis will be performed with different CE groups and polymer backbones containing QA groups. Understanding the stability of CE–QA complexes can contribute to the development of highly robust and stable AEMs for AEMFC applications.

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