הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע"ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar
Wednesday, October 21st, 2020 at 13:30

Online seminar via Zoom
https://technion.zoom.us/j/97591164072

Maya Kaduri & Karam Yassin

Using nanotechnology to target cancer associated neurons as a tool for treating breast cancer

Maya Kaduri

Ph.D. Student, Mid-seminar

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There is a connection between the nervous system and cancer progression. Cancer cells grow and invade the nerves in the tumor microenvironment, and use the nervous system as a mean for metastatic spread. Moreover, nerves and their axons actively infiltrate the tumor tissue and stimulate cancer-cell growth, proliferation, invasion and migration. These processes are promoted by cancer cells through the secretion of neurotrophic factors and cytokines, but also by the nervous system through the secretion of neurotransmitters.

In my research, I study the interactions between cancer and nerves and developed a nanotechnology to treat cancer as a single or combined therapy.

Nanotechnologies are becoming impactful therapeutic tools, granting tissue-targeting and cellular precision that cannot be attained using systems of larger scale. **We hypothesize that by reducing nerve ↔ cancer interactions via nanotechnology we will inhibit tumor growth and metastasis**.

Our preliminary results show that cancer cells stimulate neuronal growth and that, in turn, neurons stimulate cancer cell proliferation and survival. Moreover, our nanoparticles are taken up by neurons efficiently. In addition, liposomal bupivacaine that we have developed were delivered to the tumor microenvironment, inhibited tumor growth and reduced metastasis.

Modeling Anion-Exchange Membrane Fuel Cell Performance and Performance Stability

Karam Yassin

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In recent years, significant advances have been made in the development of anion-exchange membrane fuel cells (AEMFCs). In particular, new anion exchange membranes (AEMs) have been developed, exhibiting high hydroxide conductivities that significantly increase the (initial) cell performance. However, while reaching high cell performance is a valid and important goal, it is essential to achieve cell performance stability. Currently, cell life time is mainly limited by the chemical degradation of the ionomer, which is found to be associated with the low hydration levels of the fuel cell. Low water content in the cell (typically appearing in the cathode) often leads to poor ionic conductivity and degradation of the ionomeric materials while too much water leads to anode flooding leading to mass transport issues, particularly at higher current densities.

AEMFC operation involves several nontrivial physical and chemical phenomena, including multi-phase heat and mass transfer, fluid flow, and electrochemical reactions. Modeling AEMFC operation requires, therefore, the solution of several appropriate equations representing physical and chemical principles governing these phenomena. In this study, we apply a one-dimensional and time-dependent model. The model accounts for mass transport, electrochemical phenomena, and ionomer degradation kinetics across the cell, involving a five-layer membrane electrode assembly. Discretization is achieved via the Finite Difference Method and its implementation involves using a C++ platform with OpenCL technology, allowing utilizing GPU's computation power. Using this model, we highlight and discuss the effect of ionomer properties and cathode design parameters, and propose possible related routes to improve AEMFC performance.

Specifically, we show that performance stability is strongly affected by AEM water diffusivity (which impacts hydration levels) while being largely insensitive to hydroxide conductivity. The resultant conclusion from this analysis is that improved performance and performance stability can be achieved by the development of AEMs with both high hydroxide conductivity and high water diffusivity. Also, we demonstrate a quantitative analysis of AEMFC performance and its stability by calculating overpotential distributions and reaction rate profiles across the cell. By integrating theoretical and experimental studies, we aim to achieve an innovative alternative to the time-consuming trial-and-error processes currently used for AEMFC design.