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הפקולטה לכימיה ע"ש שוליך
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סמינר כימיה פיסיקלית ואנליטית

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נושא:

PHOTOCURRENT PRODUCTION FROM LIVE PHOTOSYNTHETIC ORGANISMS IN BIO-PHOTO ELECTROCHEMICAL CELLS.

ההרצאה תתקיים בחדר הסמינרים הפקולטי

Photocurrent production from live photosynthetic organisms in bio-photo electrochemical cells.

World energy consumption continues to increase each year. To meet the increasing demand, the use of fossil fuels continues at ever-growing amounts, and as a result, more pollution is released into the environment. The increase in pollution has recently become a major concern because it might cause severe climate change that will be globally detrimental. Therefore, there is an urgent need for the replacement of polluting energy production technologies with non-polluting, renewable, green energy technologies. One such technology, which is believed to be a good base for the production of green energy, is microbial fuel cells (MFCs). The main principle of MFCs is to use bacteria in electrochemical cells as electron donors at the anode. Such reduction may occur by trans-membranal conductive protein complexes or by the addition of artificial exogenous electron mediators.

A relatively new MFC technology are bio-photo electrochemical cells (BPECs), that utilize photosynthetic microorganisms (PM) such as cyanobacteria and micro-algae. It was previously reported that upon solar illumination, live PM can produce photocurrent by secretion of an endogenous electron mediator that can transfer electrons between the photosynthetic pathway inside the cells and the anode of the BPEC. Yet, the identity of these electron mediators remained elusive for more than a decade.

In my work, I have elucidated the mechanism of electron transfer in the BPEC by identifying the major electron mediator as NADPH in various cyanobacterial and microalgal species. I applied 2D – fluorescence measurements to show that an increase in the concentration of NADPH secreted into the external cell medium (ECM) is obtained by both illumination and activation of the BPEC. Elimination of NADPH in the ECM abrogates the photocurrent while the addition of exogenous $NADP^+$ significantly increases and prolongs the photocurrent production. $NADP^+$ is thus the first non-toxic, water-soluble electron mediator that can functionally link photosynthetic cells to an energy conversion system and may serve to improve the performance of future BPECs.

By far, all the BPECs that were described in the literature were limited to the utilization of microorganisms, however, I believed that macro photosynthetic organisms might also be integrated into BPECs. I designed novel BPECs that can produce electricity from live intact seaweeds and terrestrial plants. These BPECs were able to produce a photocurrent that is up to 3 magnitudes of order higher than microorganismal-based BPECs. The simplicity and high currents may pave the way towards the establishment of the first applicative BPEC based renewable energy technologies.