

תכנית האנרגיה ע"ש גרנד מתכבדת להזמין להרצאה סמינריונית שתיתן ע"י:

דן קלמן

התכנית הבין-יחידתית לאנרגיה

בנושא:

Electron extraction from photosynthetic systems in Bio-Photo-Electro-Chemical cells

Plants, algae and cyanobacteria use the sunlight to produce energy-rich chemicals in a multistep-electron-transfer process which is called photosynthesis. However, electron extraction from this well preserved path is challenging and in most cases results in the reduction of an external electron carrier with high potential and low energy, therefore it is not useful for generation of fuels. In my research I describe Bio-Photo-Electro-Chemical (BPEC) cells based on photosynthetic matter that produce hydrogen fuel with minimum or even without an external bias. A Bio-Photo-Electro-Chemical cell with cyanobacterial live cells produces H₂ while demanding less than half the bias that is needed for hydrogen production by electrolysis and maintains its functionality for hours. Moreover, these cyanobacteria cells generate 30 $\mu\text{A}/\text{cm}^2$ using only 150 μg chl without the addition of any external mediator. These live cells reduce and secrete an endogenous diffusible electron shuttle. The mediator has a redox potential of 50 mV (vs. Ag/AgCl electrode) and is smaller than 3 kD. Therefore, it might be a water soluble quinone or a derivative of Flavin. Another way to transfer electrons from photosynthesis to the electrode is by entrapping the cells inside a redox active polymer. Cyanobacterial cells embedded in an Osmium redox polymer generate 3 times the photocurrent, per cell, that is generated without the polymer. In a third BPEC, spinach thylakoids produce currents of 0.5 mA/cm² using the external electron shuttle ferricyanide. However, the photocurrent is stable for merely minutes due to photo damage to the photosynthetic proteins. In addition, the spinach thylakoids produced fuel from the sunlight without the need for an external bias in a tandem BPEC cell where a silicon solar cell, that absorbs light not used by the thylakoids, generates the extra voltage to produce the hydrogen.

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