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INTRODUCTION

Biohybrid solar cells are the new type of green renewable energy that has been introduced. By using Photosystem I (a photoactive protein complex) one can utilize the natural process of photosynthesis to convert solar energy to electrical power.

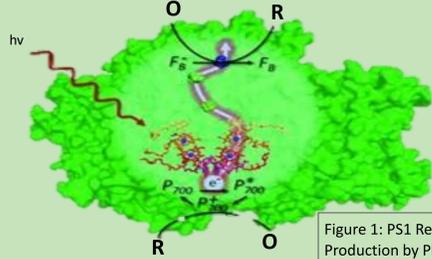


Figure 1: PS1 Redox Reaction | Enhanced Photocurrent Production by Photosystem I Multilayer Assemblies, 2010

P₇₀₀ site within PSI that can accept electrons from a wide range of donors and F_x site that has a reducing potential near -0.6V vs. SHE.

OBJECTIVE

❖ Create Gel-State Biohybrid Solar Devices:

- Use agar gel coupled with varying mediators; exploring different concentrations
- Investigate different metal cathodes
- Test the effects of PSI with these variations

APPLICATION

Biohybrid solar devices can be used in various devices such as calculators, medical appliances and solar panels.

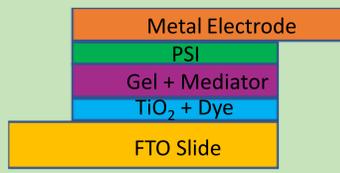


Figure 2: Representative device schematic

METHODOLOGY

1. FTO slides are plasma cleaned and TiO₂ coated.

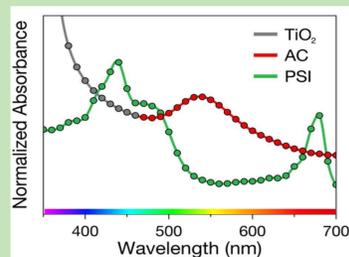
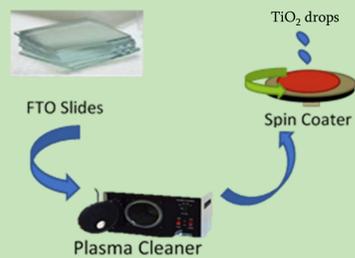
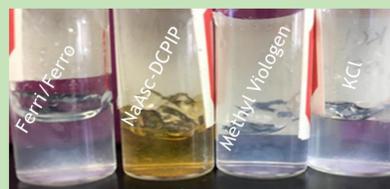


Figure 3: TiO₂, Anthocyanin (AC) and PSI Absorbance | Maxwell T. Robinson, ACS Appl. Energy Mater. 2018, 1, 301-305



2. Slides are dye sensitized with blackberries to improve overall light utilization.

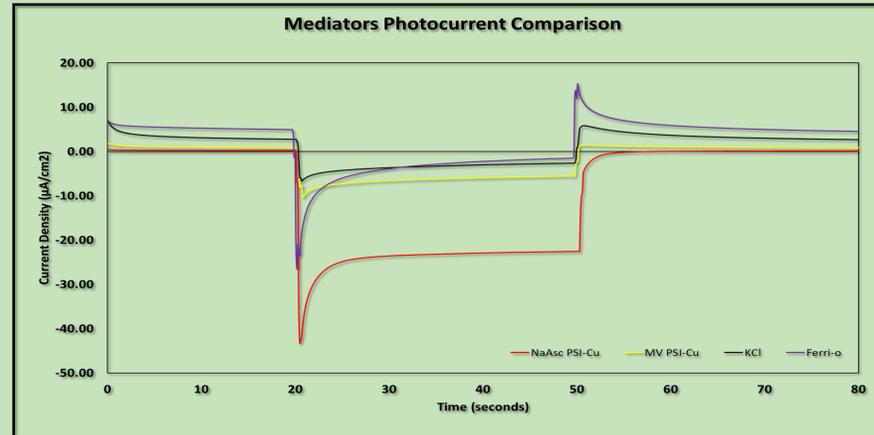


3. Agarose based gel is made with different mediators.



4. PSI coupled with metal electrode is added to complete the device and photochronoamperometric tests are run.

PHOTOCURRENT RESULTS



- ❖ Four mediators were examined and for each mediator three cells were examined: one without PSI, one with PSI on the cathode and the other with PSI on the anode.
- ❖ Sodium Ascorbate(NaAsc)-DCPIP with PSI on copper was the best performing configuration.

REDUCTION POTENTIALS AND CATHODE COMPARISONS

- ❖ Reduction potentials of the cathode, donor, PSI, acceptor and anode help to explain the electron flow and disparity between photocurrents.

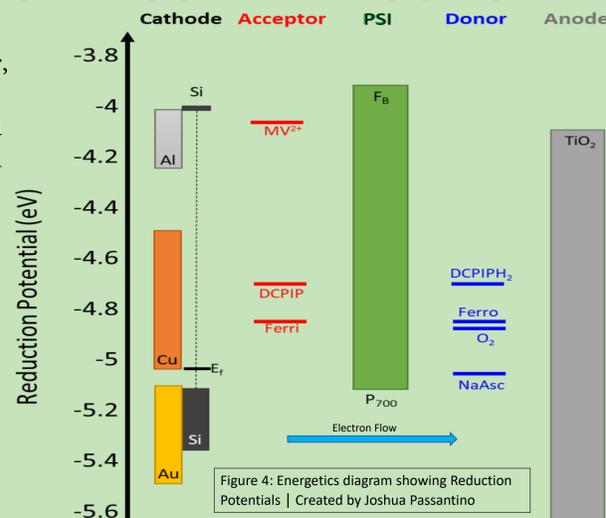
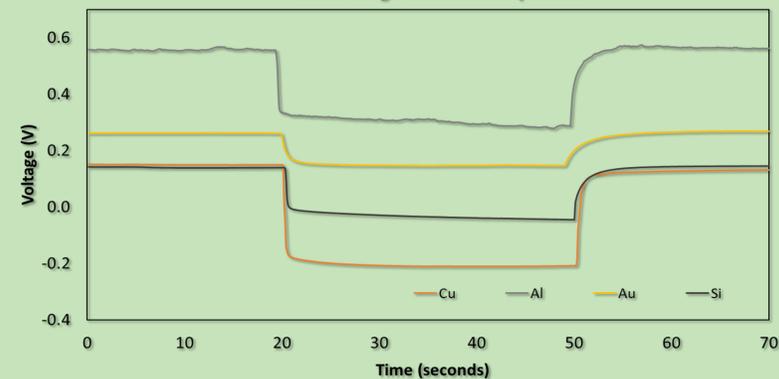


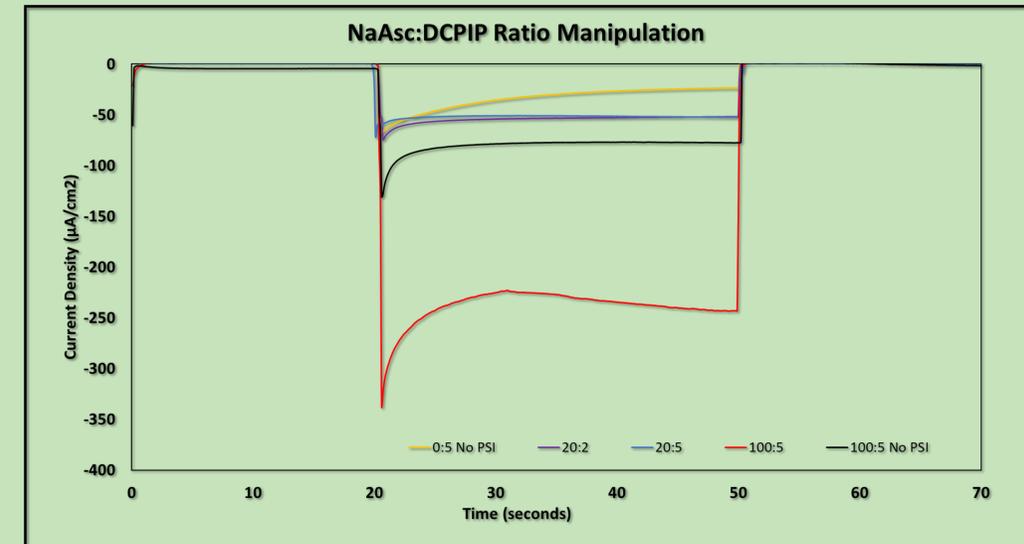
Figure 4: Energetics diagram showing Reduction Potentials | Created by Joshua Passantino

- ❖ The reduction potential of copper allows for the optimum transfer of electrons within the biohybrid devices.

Photovoltage Cathode Comparison



OPTIMIZATION OF THE NaASC/DCPIP MEDIATOR



- ❖ We used ratios of NaAsc:DCPIP — [0:5, 20:2, 20:5 and 100:5]
- ❖ 100:5 concentration increase improved the photocurrent significantly; if a few of these devices were grouped together in a series to add voltage, one can power a small device.

CONCLUSION & FUTURE WORK

- ❖ NaAsc-DCPIP functions as the best mediator for this system.
- ❖ PSI on the cathode increases photocurrent.
- ❖ Devices are organic, inexpensive, easy to fabricate and process.
- ❖ For our future work we can add the mediator Methyl Viologen to the NaAsc/DCPIP which should increase photovoltage and photocurrent.

ACKNOWLEDGEMENTS

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