Introduction

- Photosystem I (PSI) is a membrane-bound protein found in higher order plants that acts as a natural photodiode.
- PSI can be used in solar cells as a photodiode which, utilizes light to generate an electron-hole pair.
- Bio-derived solar cells can provide remarkably clean energy and utilizing PSI affords an abundant, low-cost material for solar cells.

Natural Orientation of Photosystem I

In Nature, Photosystem I is oriented uniformly in the thylakoid membrane found in chloroplasts, and operates by shuttling electrons across the membrane unidirectionally.

To achieve maximum current in a solar energy conversion device with PSI, the orientation of PSI must be uniformly controlled.

In Situ Modification of Photosystem I

In order to orient PSI, an in situ modification was performed using 2-iminothiolane (Traut’s Reagent) to modify one side of the protein with the thylakoid membrane acting as a ligand barrier.

Chemical modification with 2-iminothiolane provides a vector for orientation via gold-thiol interactions.

Quantifying Chemical Modification

Ellman’s Assay was used to quantify the number of new thiols on PSI via a colorimetric change at 412 nm.

Quartz Crystal Microbalance (QCM)

QCM can be utilized to show a preferential binding from thiolated PSI via a mass change on the gold crystal surface.

- Sonating the QCM crystal removes the unmodified PSI indicating non-specific binding.
- Future QCM experiments with Trauts modified PSI aim to show stronger substrate binding to gold surfaces.

Photochronoamperometric Analysis

Electrochemical analysis indicates an increased photocurrent from a modified PSI monolayer.

- UV light deactivation provides a control for PSI with similar surface chemistry.
- Future research includes optimizing electronic interactions with Trauts modified PSI.

Conclusions

- Photosystem I can be modified in situ with Traut’s Reagent.
- Future experiments aim to show that Trauts modified PSI has a stronger gold binding affinity than unmodified PSI.
- Electrochemical analysis indicates that Trauts modified PSI has increased photocurrent when compared to unmodified PSI.

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References