

Enhancement of Solar Energy Conversion in Bio-Derived Cells via Side-Selective Modification of Photosystem I



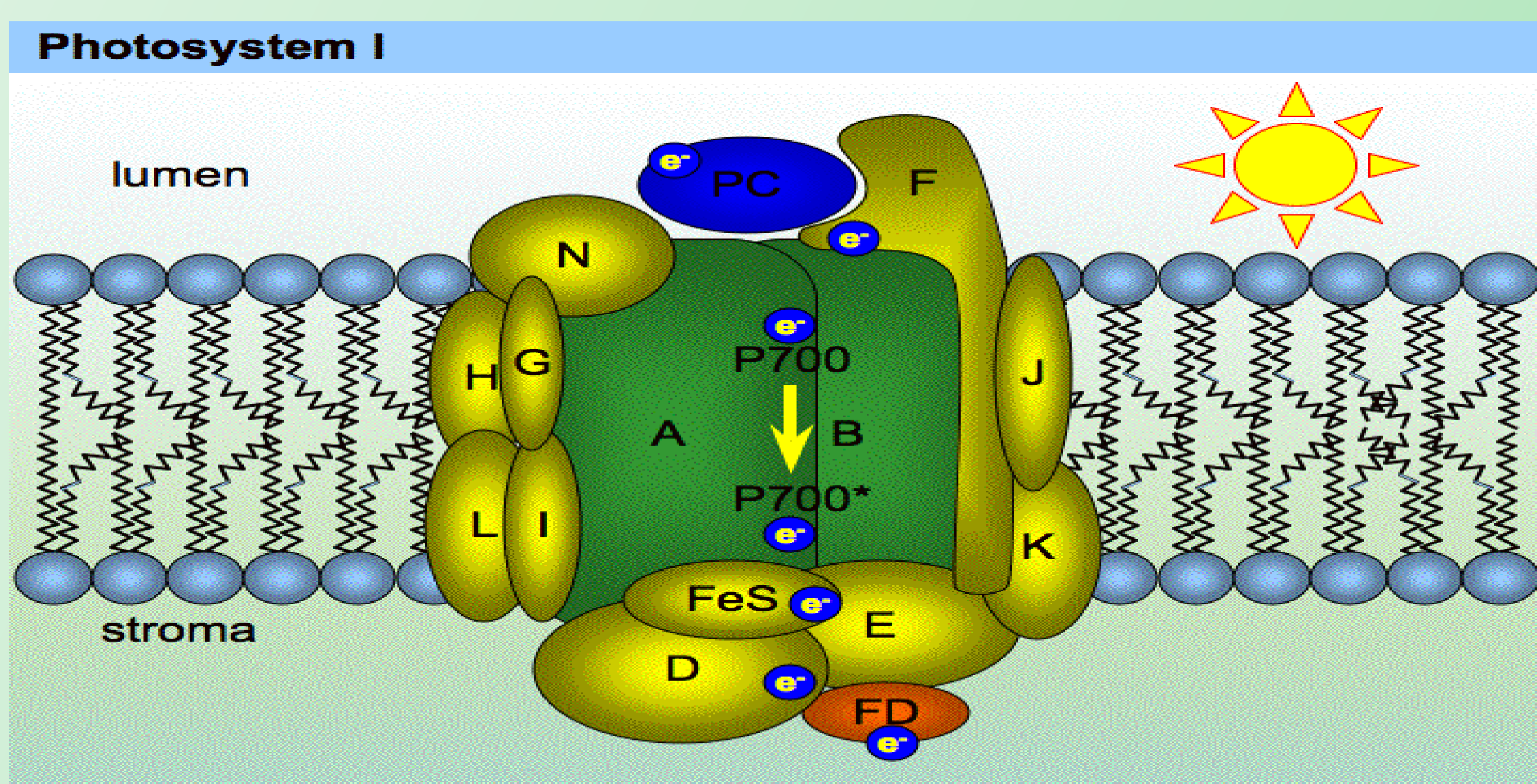
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Motivation

- Bio-derived cells containing PSI address the issues faced by current solar cell technology: extensive processing methods, high cost, and need for rare materials

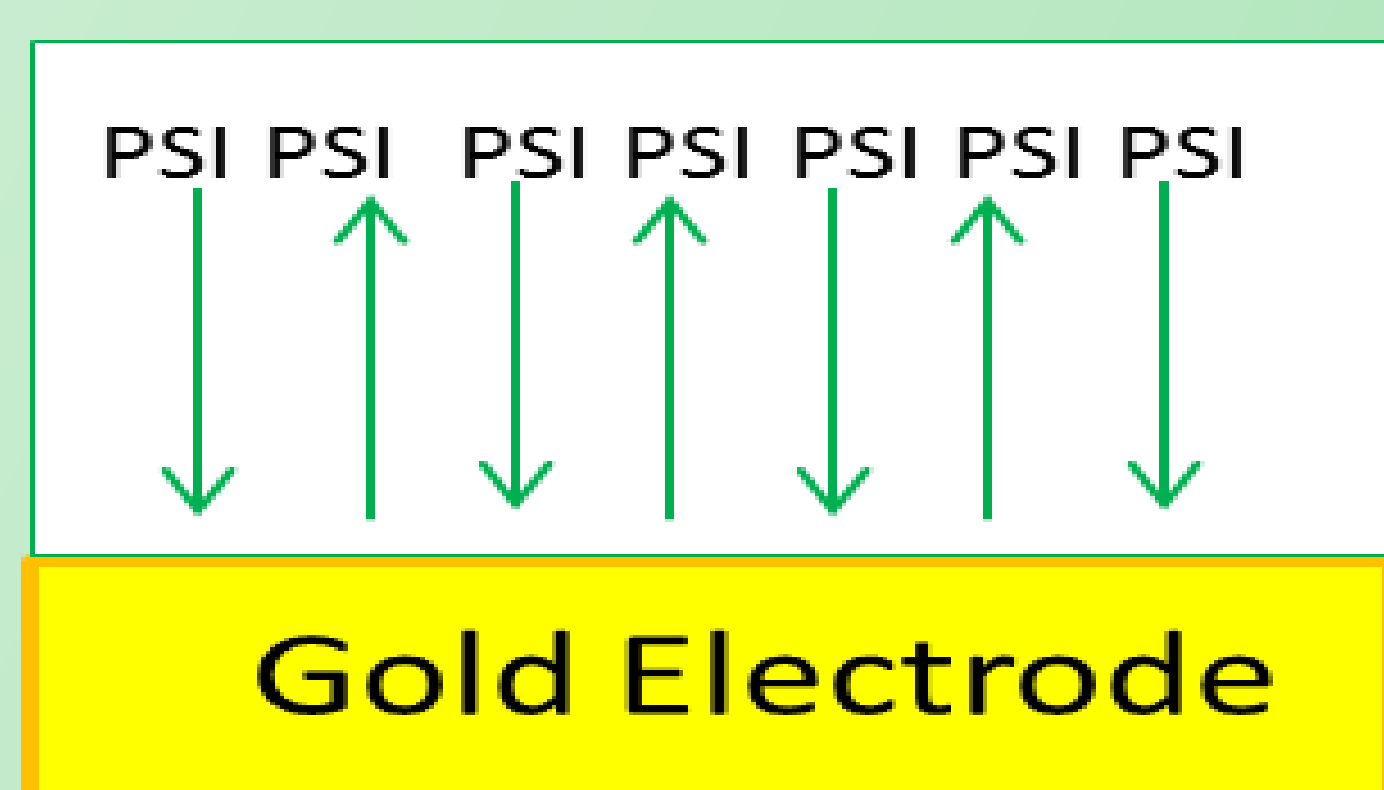


- Abundant
- Very efficient
- Low-cost
- Rapid charge separation

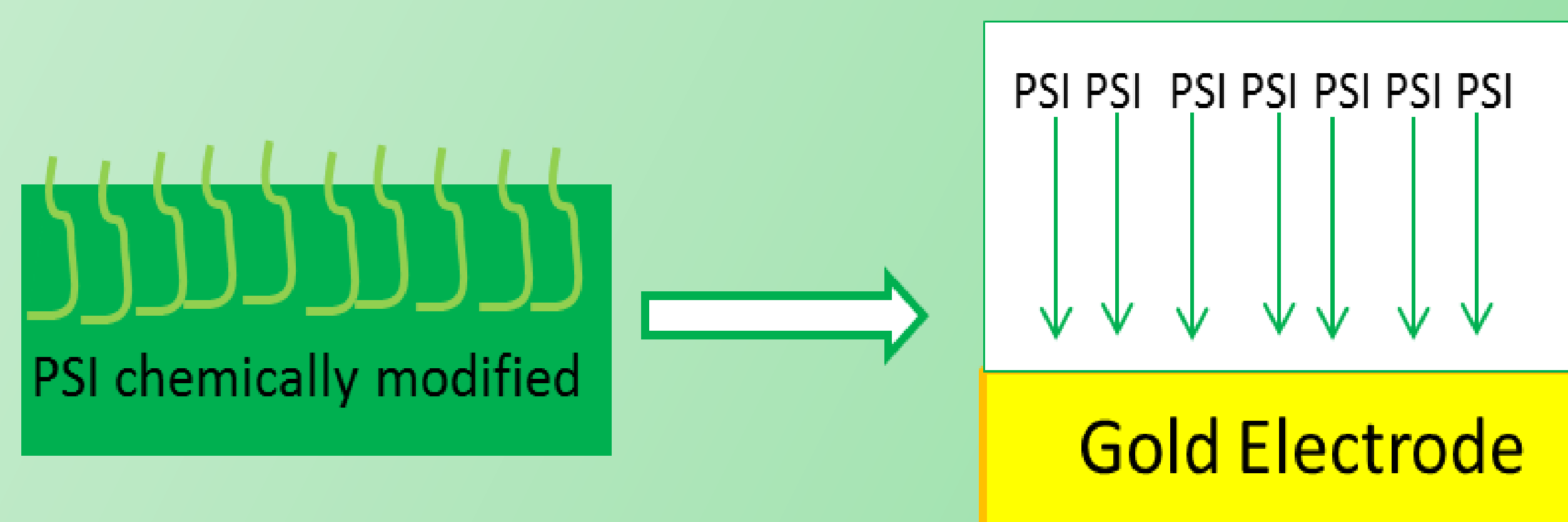
Koning, R. Light Reactions. http://plantphys.info/plant_physiology/lightrxn.shtml (accessed July 21, 2015.)

Objective

- Enhance solar energy conversion by increasing the orientation of PSI on gold electrodes via side-selective modification of PSI



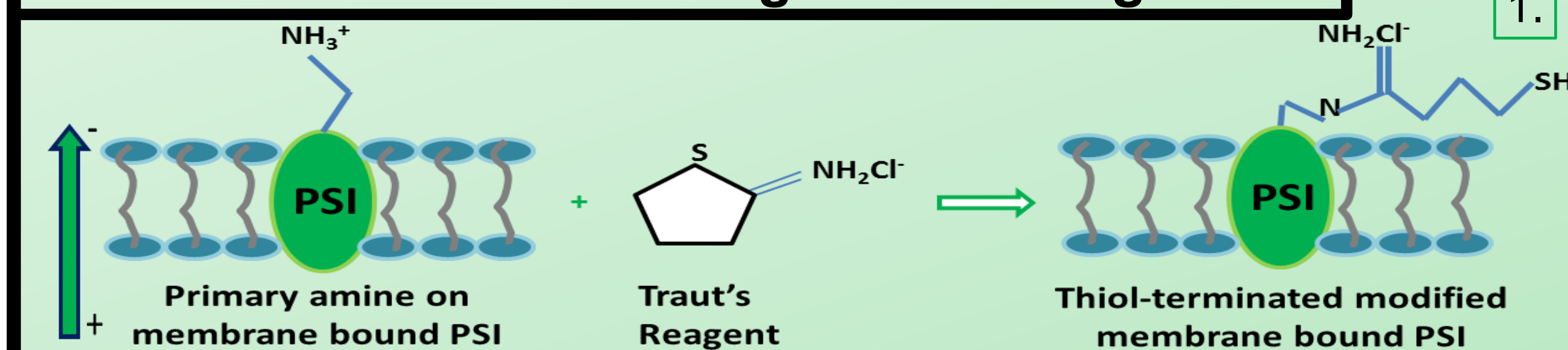
- Unmodified PSI randomly assembles on gold surface in upright and inverted directions



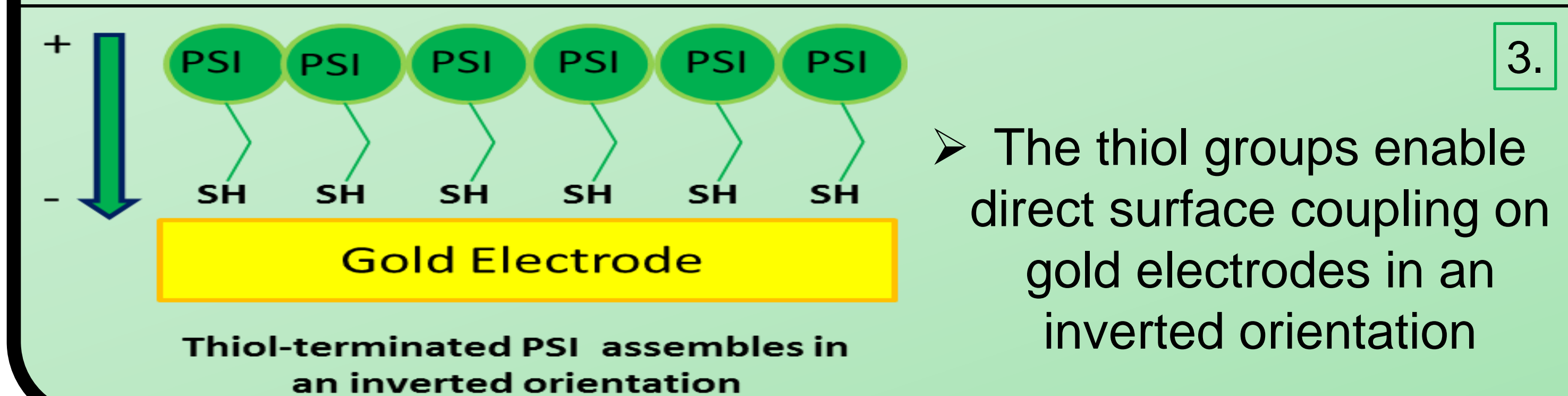
- Side-selectively modifying PSI provides a vector for directed assembly in an inverted orientation

Side-Selective Modification of PSI

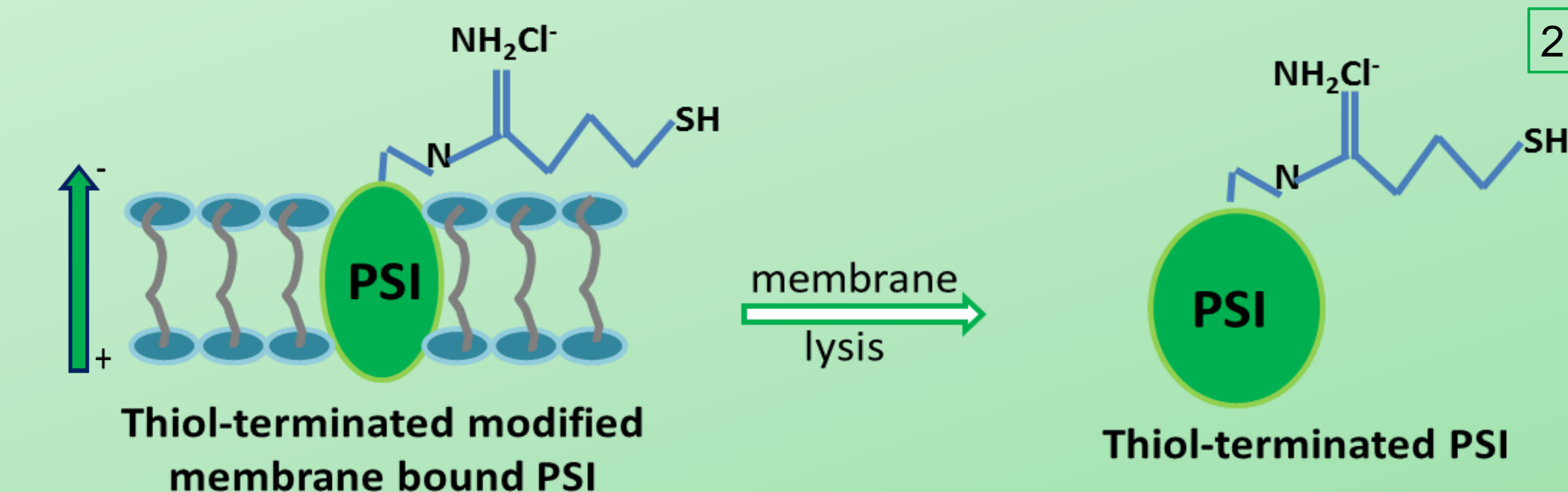
Chemical Modification using Traut's Reagent



- Reaction with Traut's reagent introduces the thiol group to the membrane bound protein



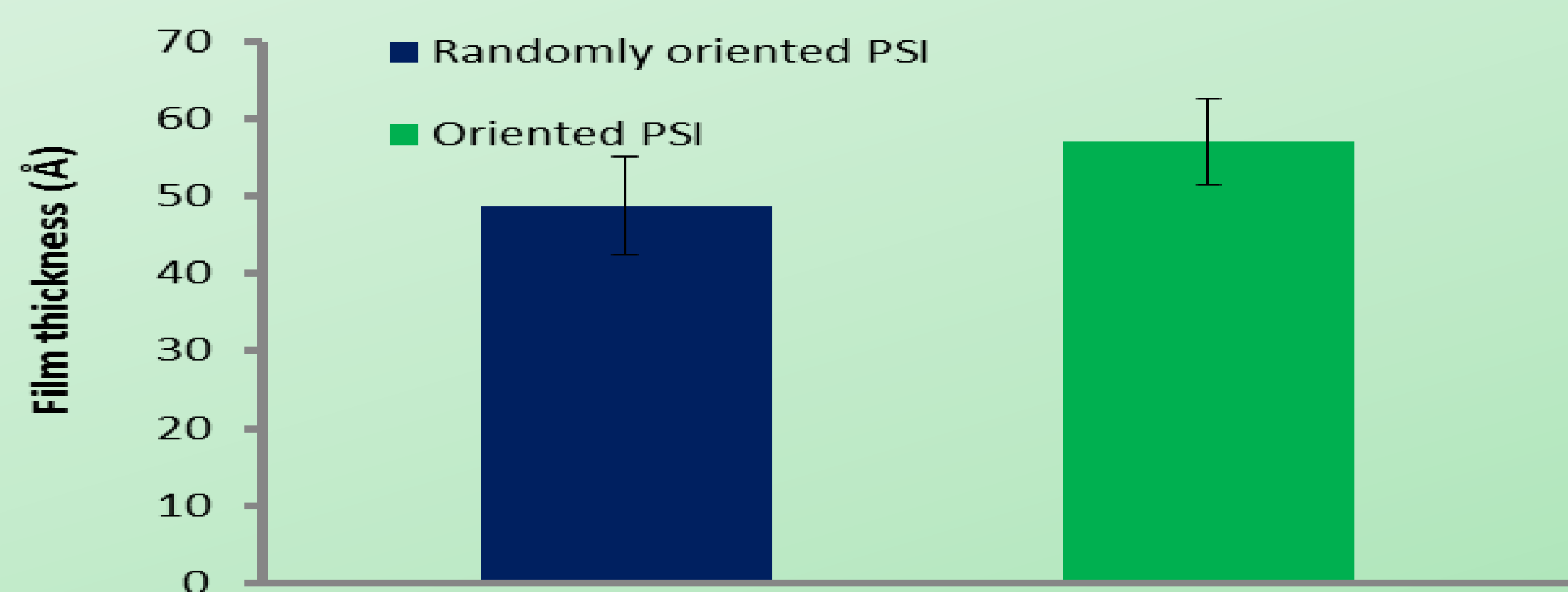
- The thiol groups enable direct surface coupling on gold electrodes in an inverted orientation



- Membrane lysis was done to extract the PSI from the membrane and at this point, it is able to freely assemble on the gold electrodes
- Column separation was done to purify the extracted PSI solution

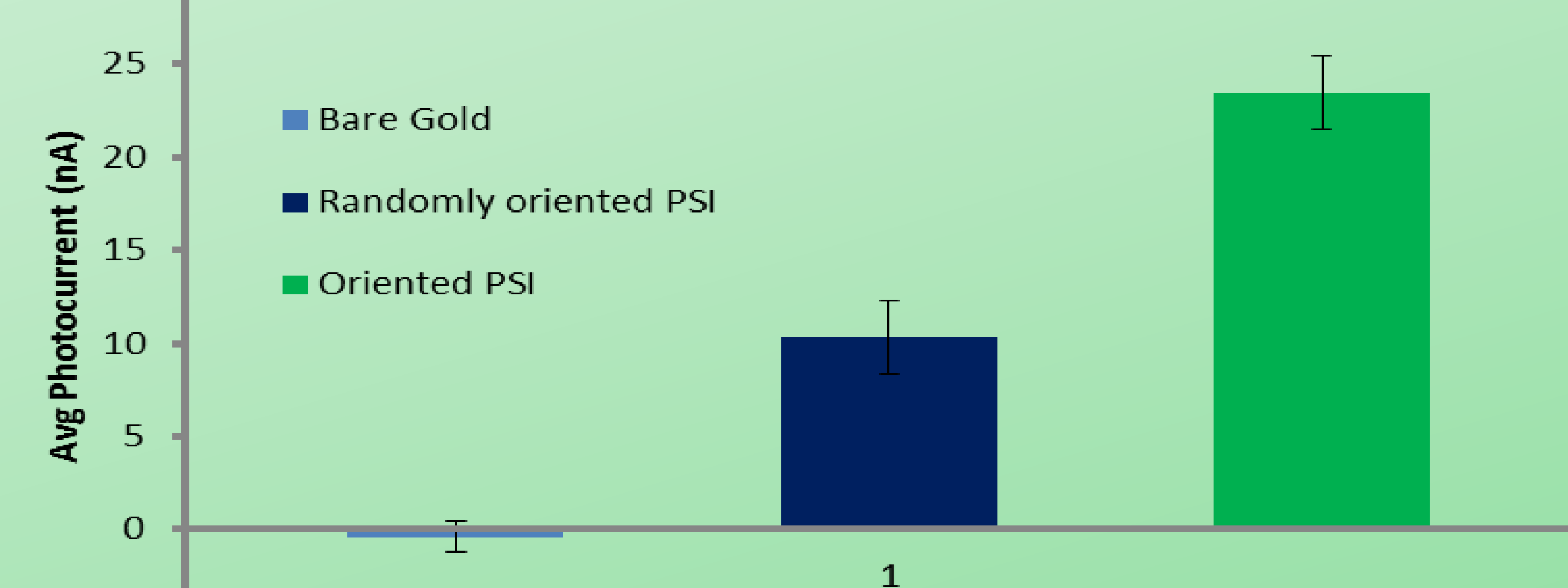
Ellipsometry & Photoelectrochemical Analysis

Film Thickness of PSI



- Created a monolayer of PSI film with improved surface packing and orientation control

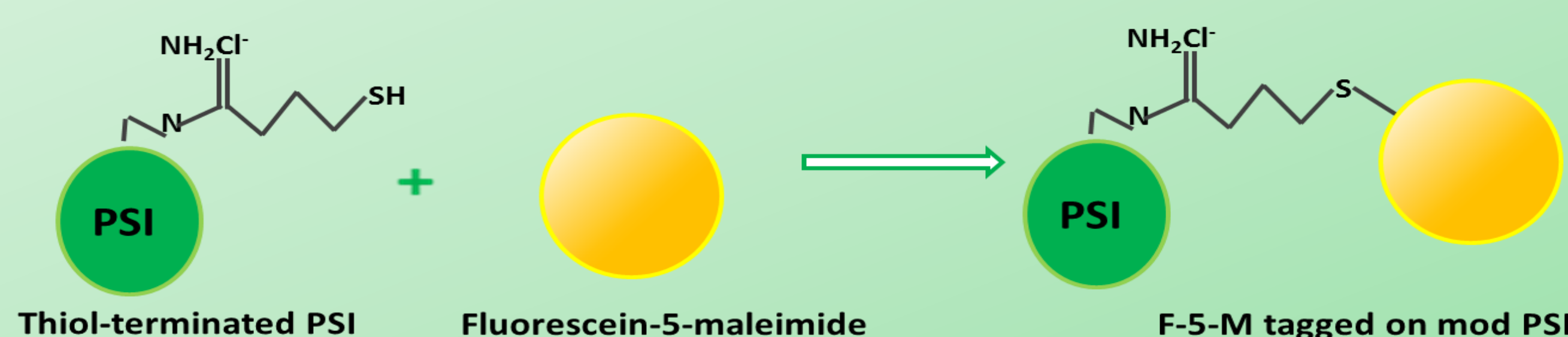
Photocurrent



- Analysis on the modified PSI film shows an enhancement in photocurrent

Conclusion & Future Directions

- Ellipsometry and photoelectrochemical analysis reveal that enhancement in photocurrent is a result of side-selective modification of PSI



- Ligand quantification via fluorescein tagging using fluorescein-5-maleimide
- Scanning electrochemical microscopy approach curves

Acknowledgements



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