Polymerization of Aniline by Photosystem I Proteins
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Renewable Energy
• The use of solar energy is increasing
  - Renewable energy makes up about 15% of all electricity in the US and solar energy generates about 7% of that electricity
  - Last year, solar energy produced 1% of the electricity used globally
• Problems with silicon solid-state solar cells include:
  - High production costs
  - Large energy waste

Photosystem I (PSI)
• Essential photosynthetic protein
• Photosystem I is easy to extract, afford, and find
• Two reaction centers:
  - P680 and F3 site where oxidations and reductions happen respectively
• Electron transport is unidirectional

Polyaniline (pAni)
• Polyaniline has been shown to have exceptional charge transfer materials when in redox mediated biohybrids cells
• Aniline undergoes oxidative polymerization to create pAni which would happen at the P680 Site
• Water soluble and capable of being electropolymerized at potentials compatible with PSI
• Many different forms of pAni
  - All varying in oxidation states

We can polymerize aniline using Photosystem I proteins. Since pAni is formed through an oxidative polymerization, it will attach itself to the PSI P680 site and create a protein polymer

Methods
• Extract PSI from spinach
• Add 30 mM of aniline to 3 µM of PSI solution
  - We began making solutions with
  - Let solution sit in direct light for 30 min to let photoexcitation reactions take place to promote pAni growth
  - Dialyze solution overnight to remove excess aniline
• Characterization methods:
  - Cyclic Voltammetry
  - FTIR

FTIR for pAni Samples
• Small broad peak at 1000-1200 cm⁻¹ and 1900-2000 cm⁻¹ indicative of pAni
• No peak at 1600 cm⁻¹ which means no aniline
• pAni peaks are difficult to see since PSI is much larger making it dominate the IR spectra

Conclusions
We conclude that we have polymerized pAni with the PSI protein due to our results. We also conclude that the pAni we have made is attached to the PSI proteins.

Future Work
• More IR studies with just pH 4 and 5
• Vary the amount of aniline in solution
• Dope pAni using camphorsulfonic acid to increase conductivity
• Run UV-Vis to try and confirm pAni in our samples
• Run time study on with microscope to monitor growth

References

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