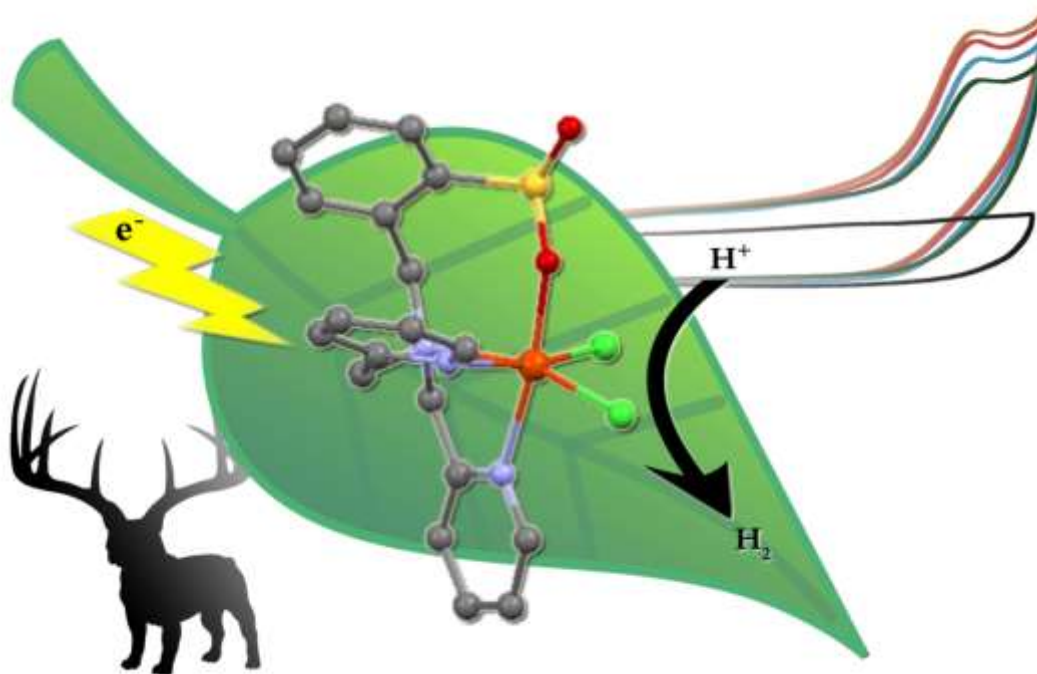




Artificial Photosynthesis: Strategies for Solar Fuel Production

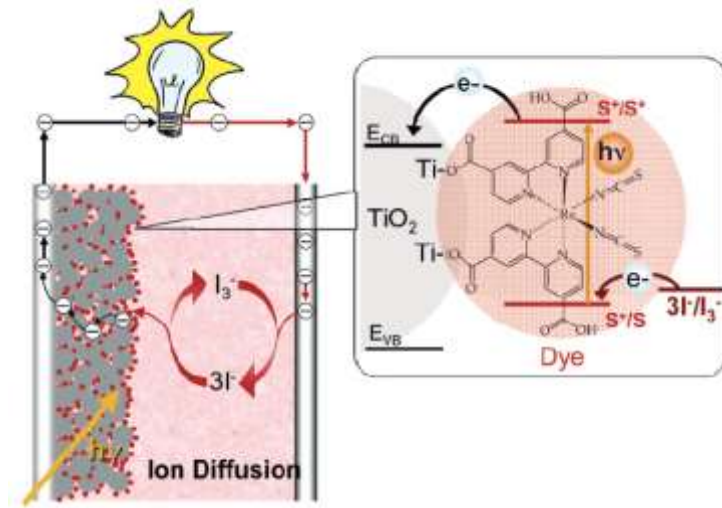
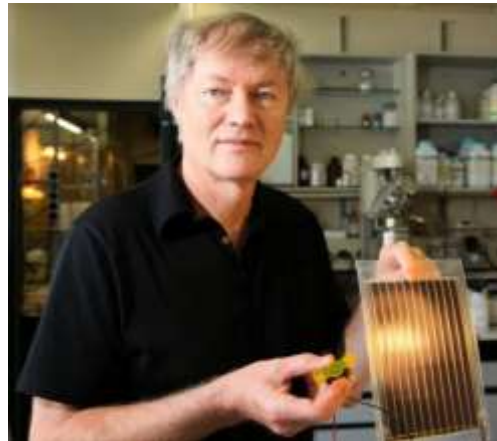
McNamara Research Group





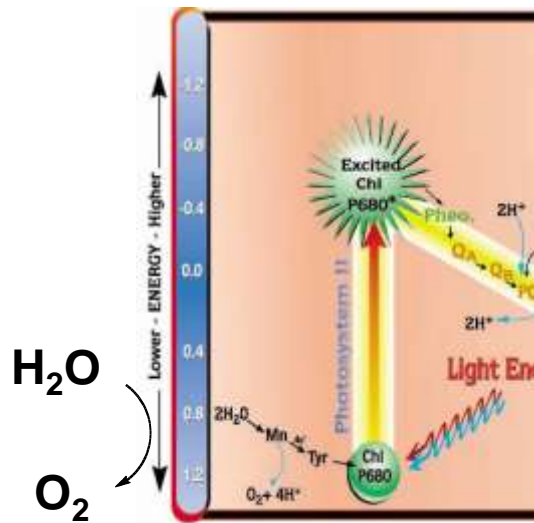
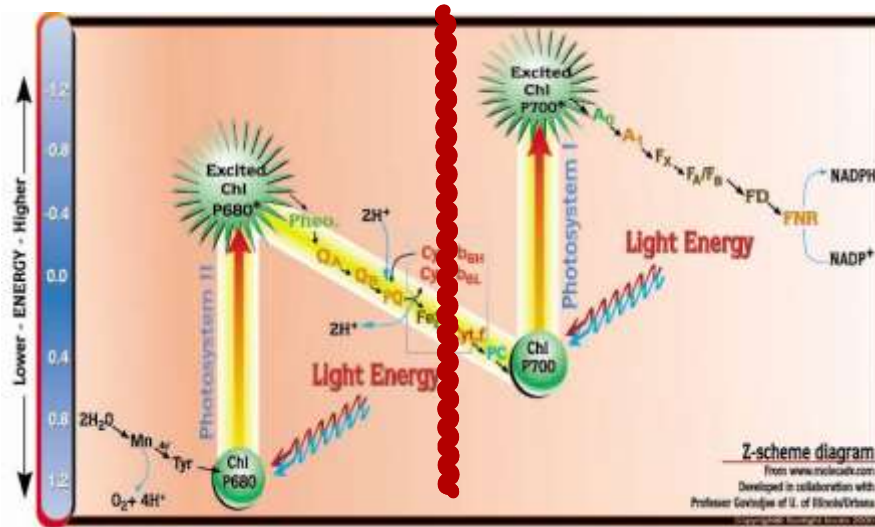
Why Solar?

- 20 TW of energy consumed globally per year
- 1.2×10^5 TW of solar energy potential
- Can be harnessed and used for fuel (plants) and electricity (humans)
- No emission of CO_2
- Political and environmental drawbacks of oil.



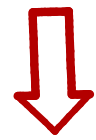


Strategy for Artificial Photosynthesis

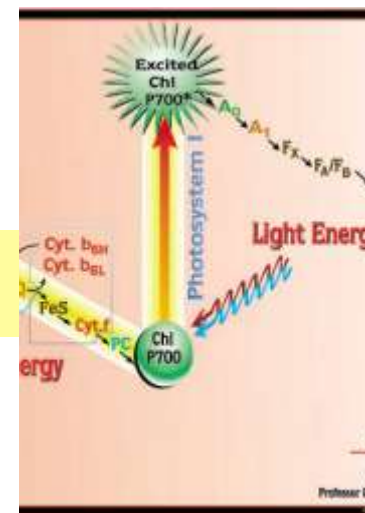


Water Oxidation

Electron
Acceptor

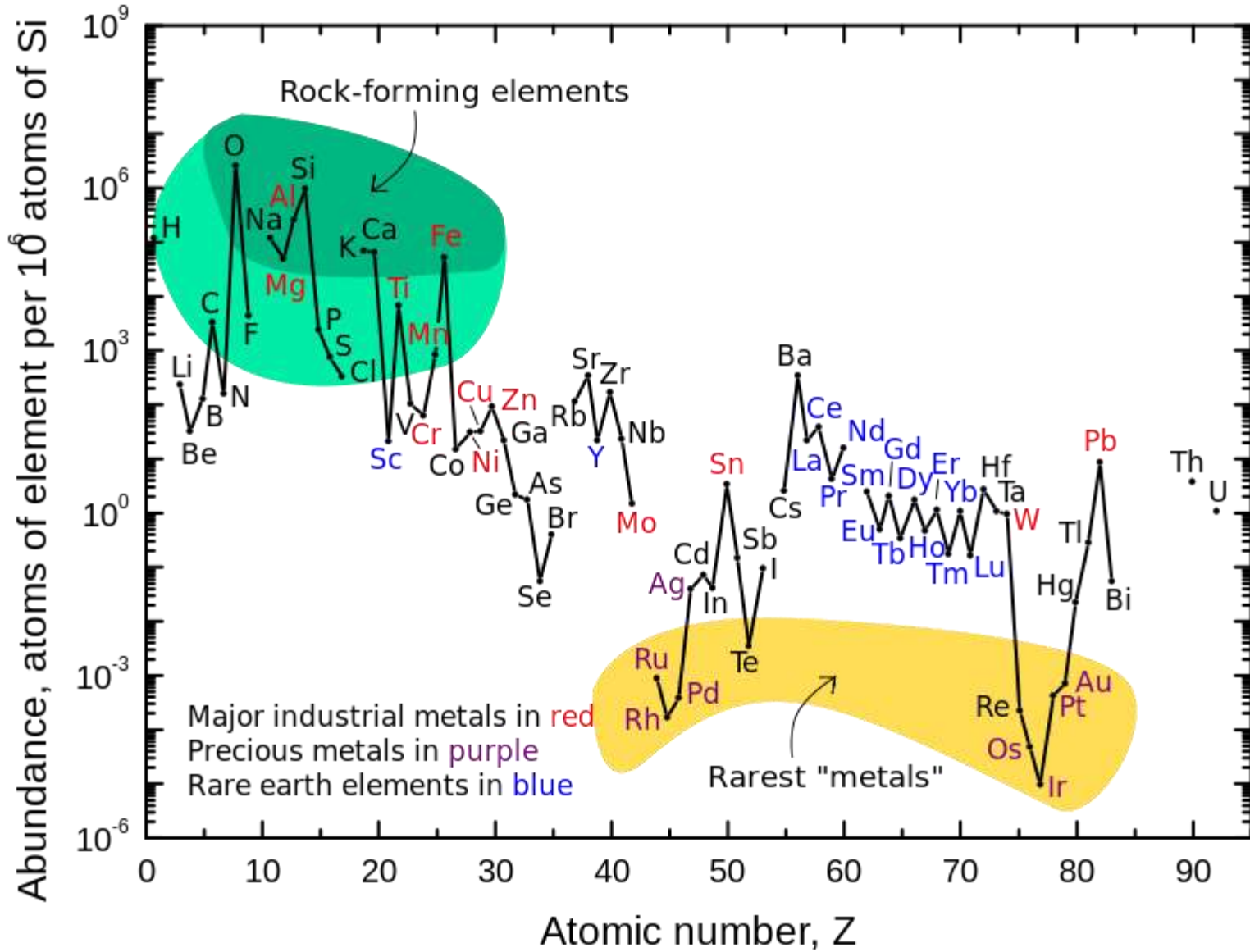


Electron
Donor



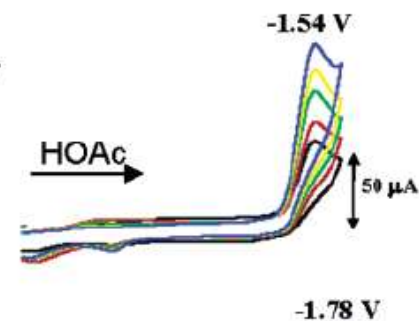
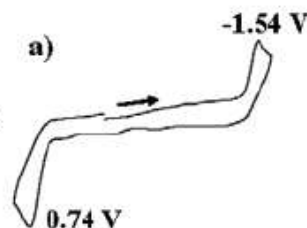
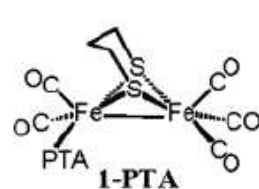
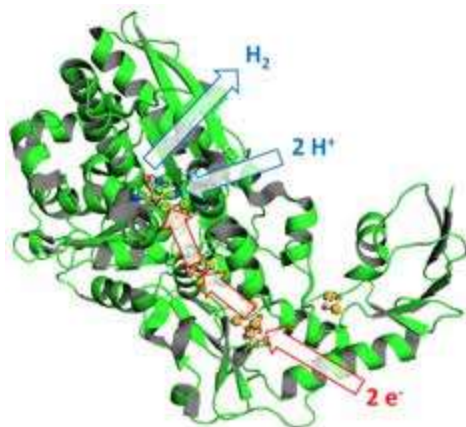
Water Reduction

Abundance of Elements

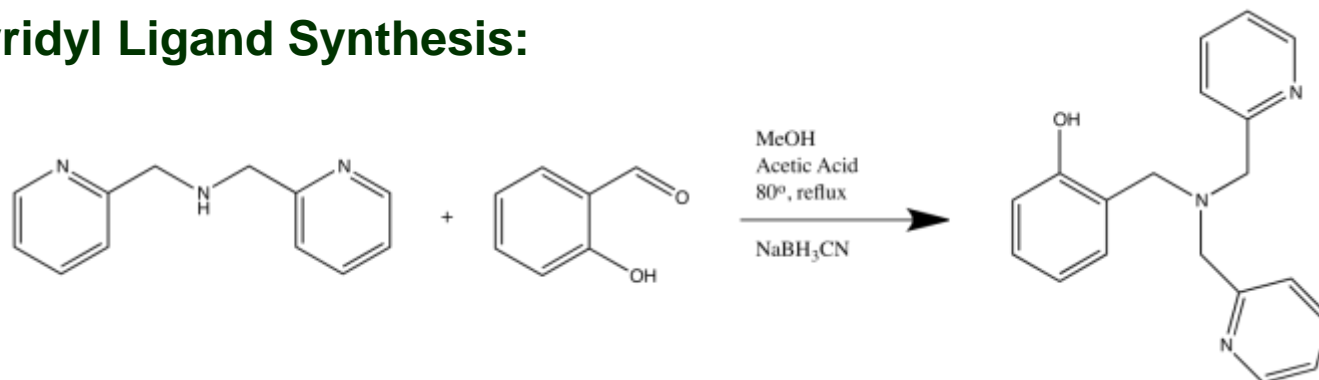




Hydrogenase Mimics

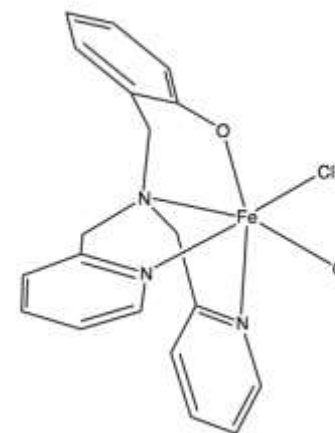
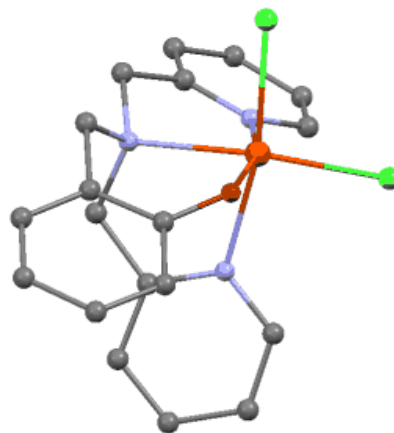
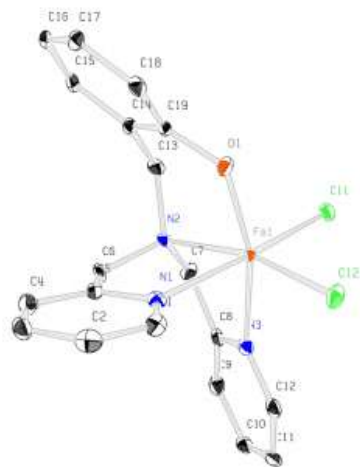
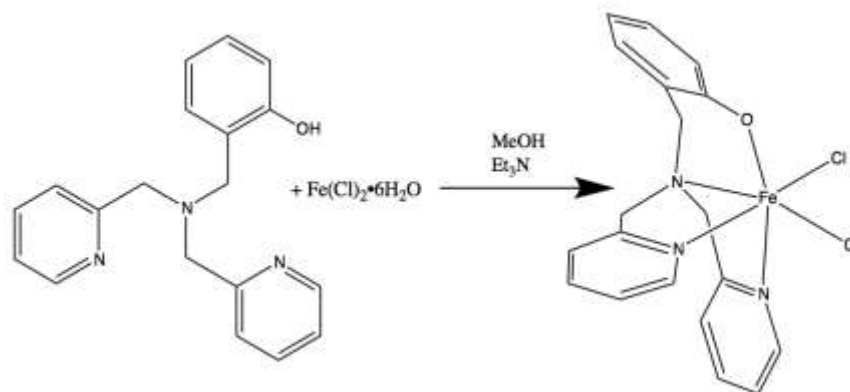


Polypyridyl Ligand Synthesis:

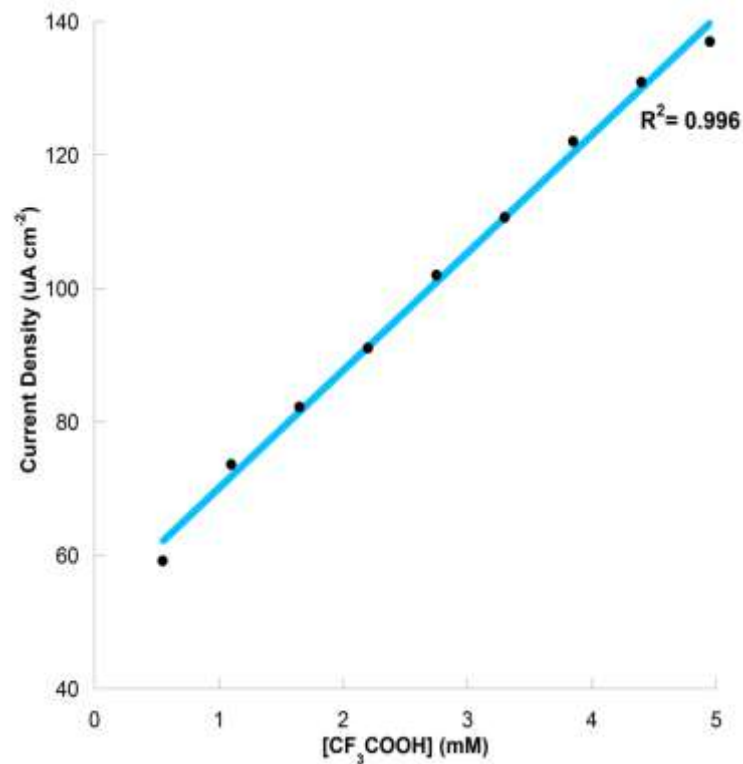
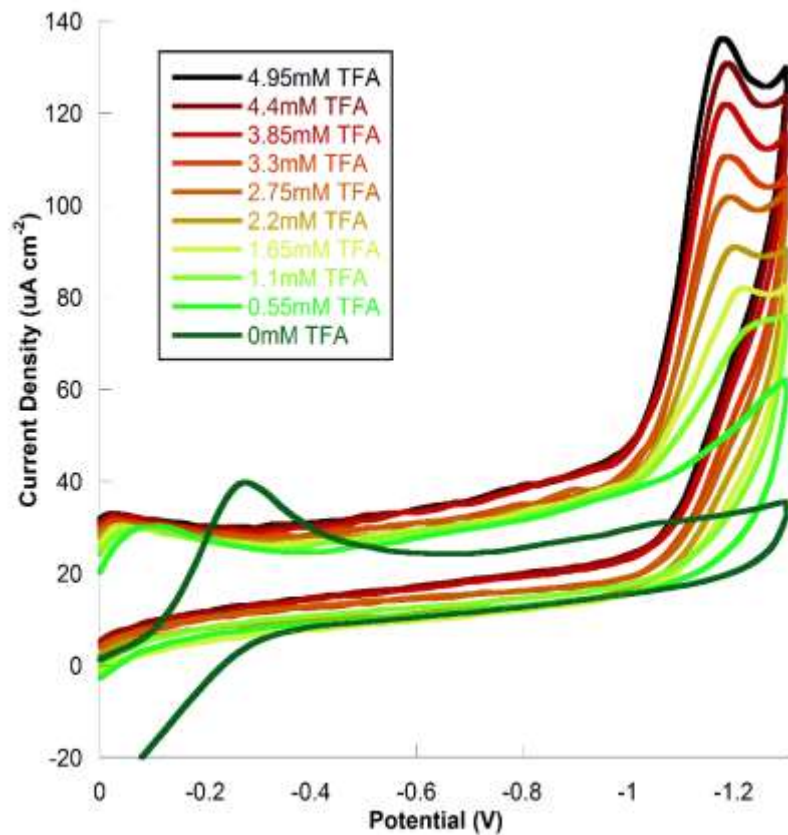


Darensbourg et al. *J. Am. Chem. Soc.* **2004**, 12004-12014

Tetradentate Fe Complex

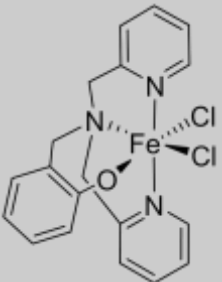
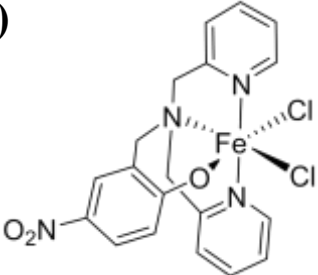
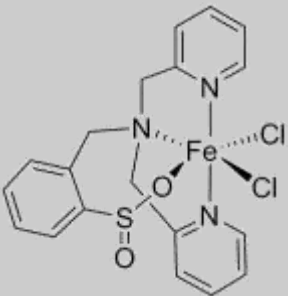


Activity of Fe-NNNO Complex

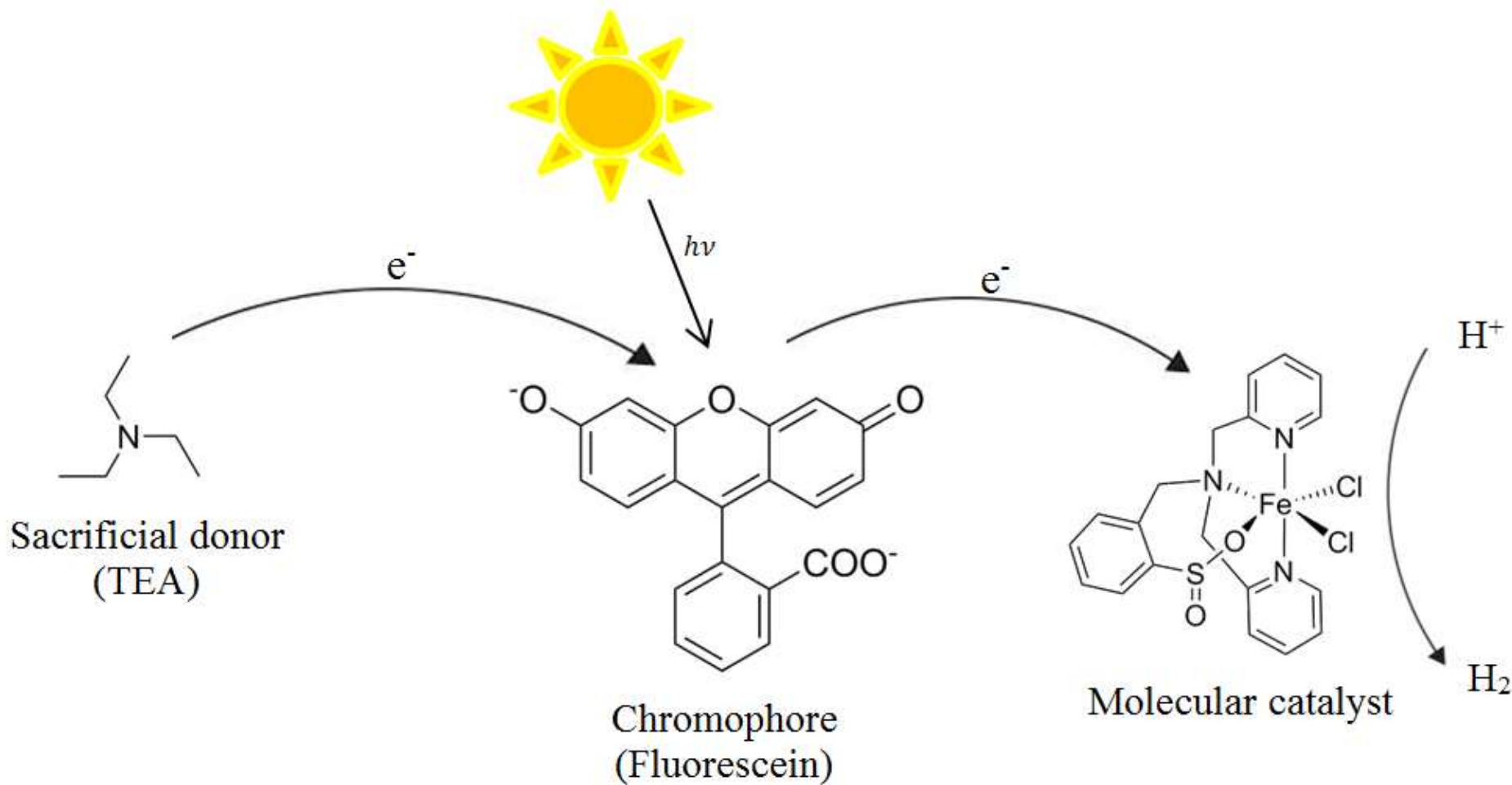


Catalyst Variations



Catalyst	i_c/i_p	Overpotential	Water?
(1) 	7.8	800 mV	Improves Greatly
(2) 	4.7	300 mV	Improves 12%
(3) 	13	800 mV	Improves 11%

Photocatalysis





LED illumination

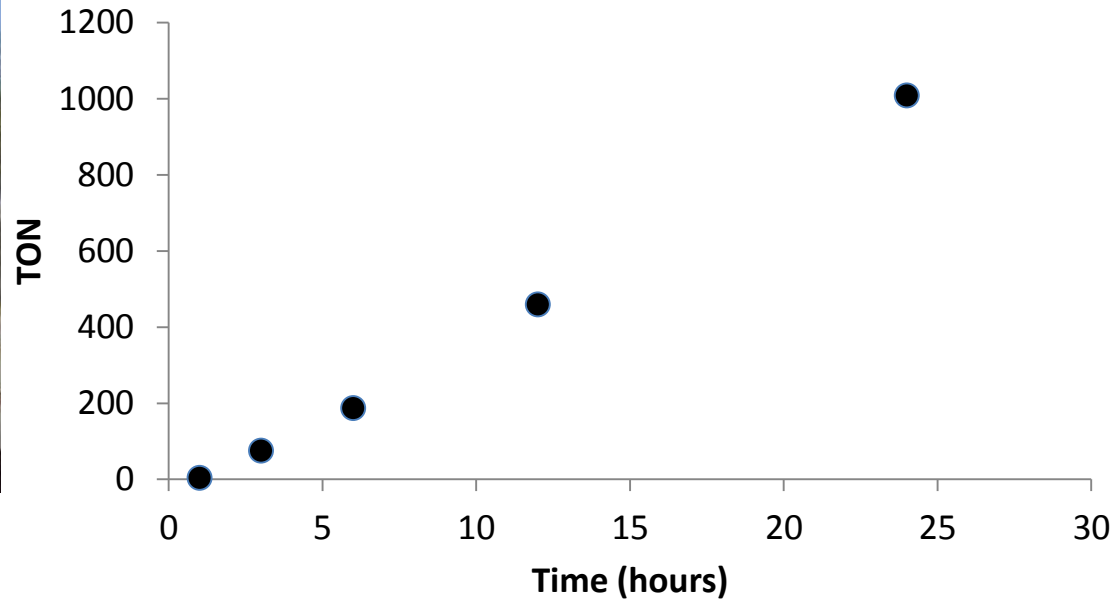
Temperature Controlled

~~EDM ball spinner~~ Disco ball motor rotates 6 samples

Using “Dirty Water”



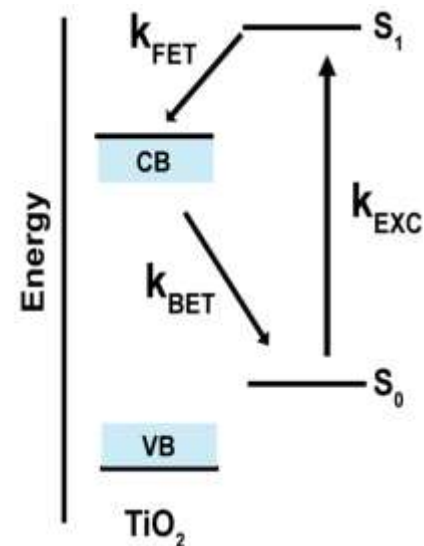
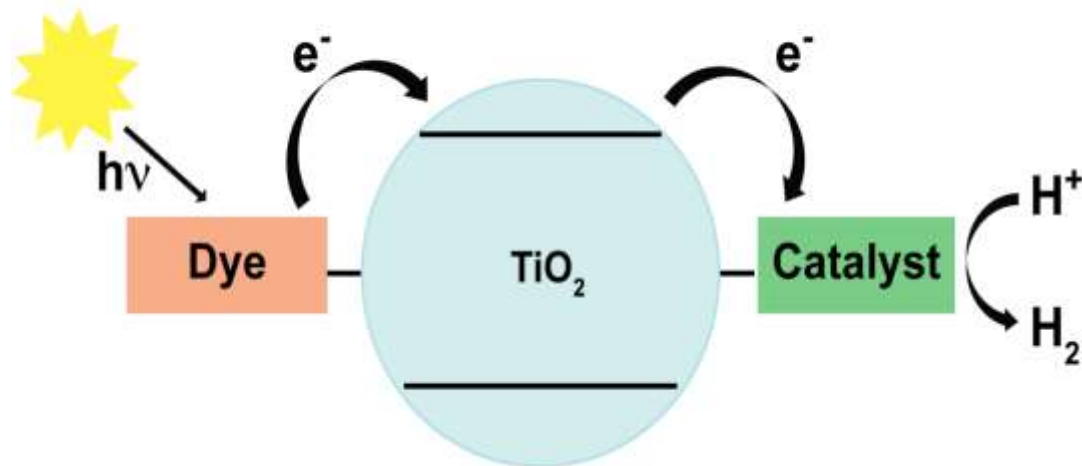
H₂ Generation Over Time



After 24 hours:

- **Over 1000 TON**
- **Over 180 μL H₂ generated**

Heterogeneous Systems



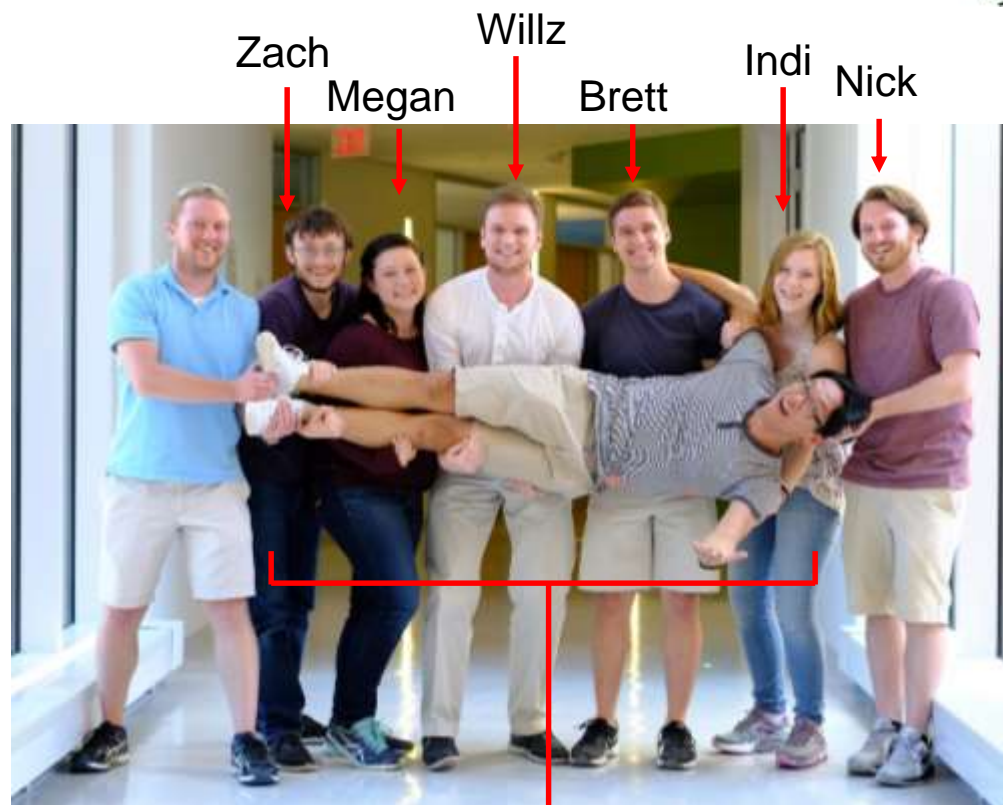
Goal: attach dye and catalyst to semiconductor to make integrated system for hydrogen generation

The study of electron transfer is in collaboration with the Wustholz group at WM

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- Jason Fulbrook ('14, GS1 VCU PharmD)
- Prof. Robert D. Pike (WM)



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Questions?



Come see me if interested!!
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