Electrochemical deposition of titanium dioxide thin films

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Photo-electrochemical hydrogen production from water using solar energy

- Hydrogen has high energy density, it is environmentally friendly, and a virtually unlimited source
- Find efficient and economic ways for storage, transportation, production and consumption of hydrogen
- Professor McFarland research lab focuses on the production of hydrogen(H_2).
- Combinatorial methods for discovery of new photocatalytic materials for hydrogen synthesis
- Electrochemical deposition of titanium dioxide (TiO_2) thin films

Photocatalytic materials for Water-Splitting

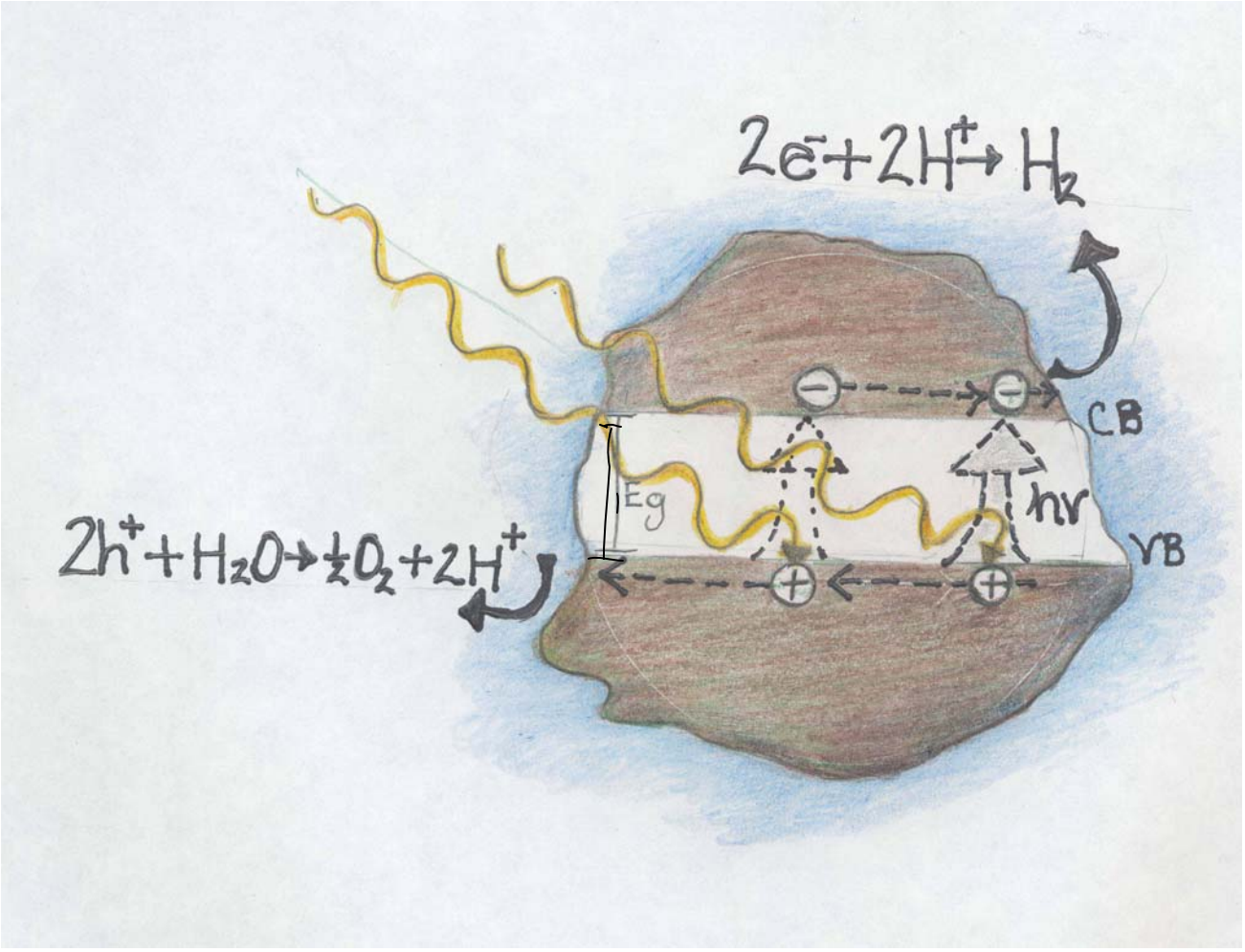
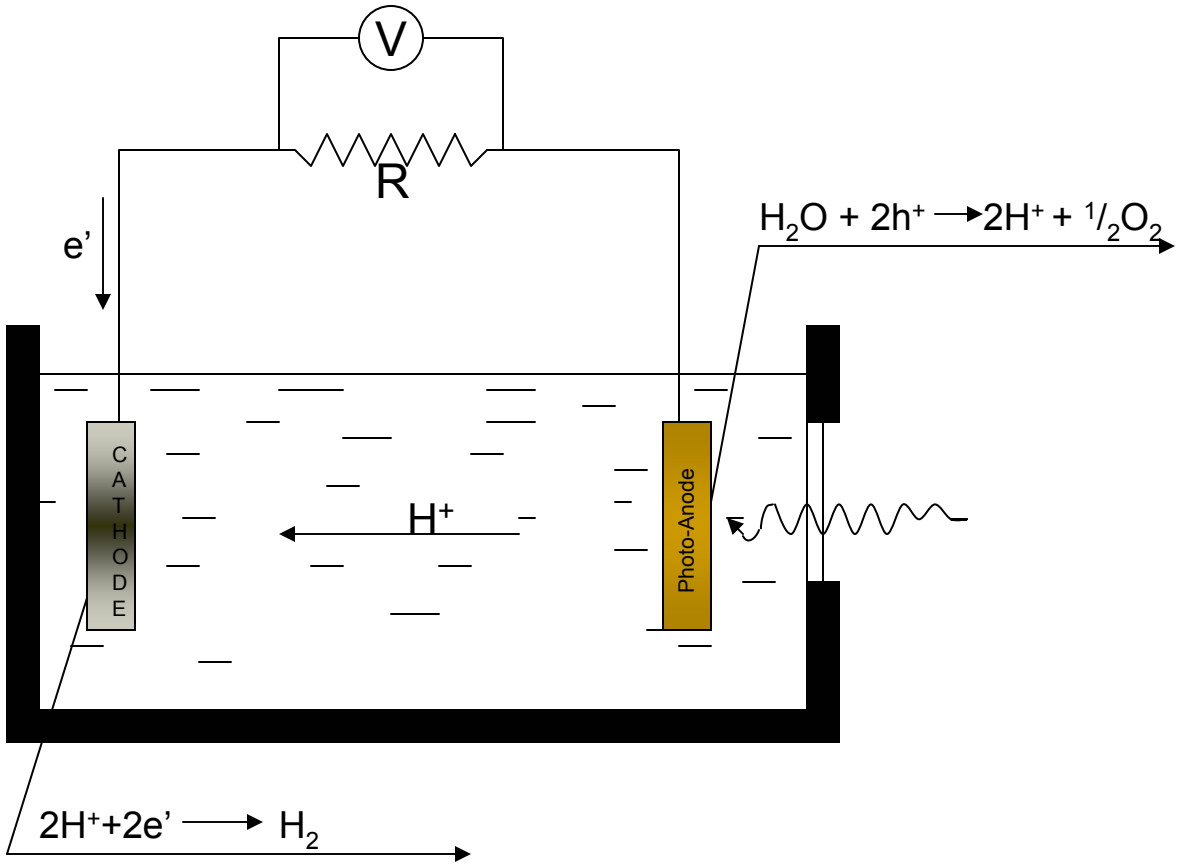


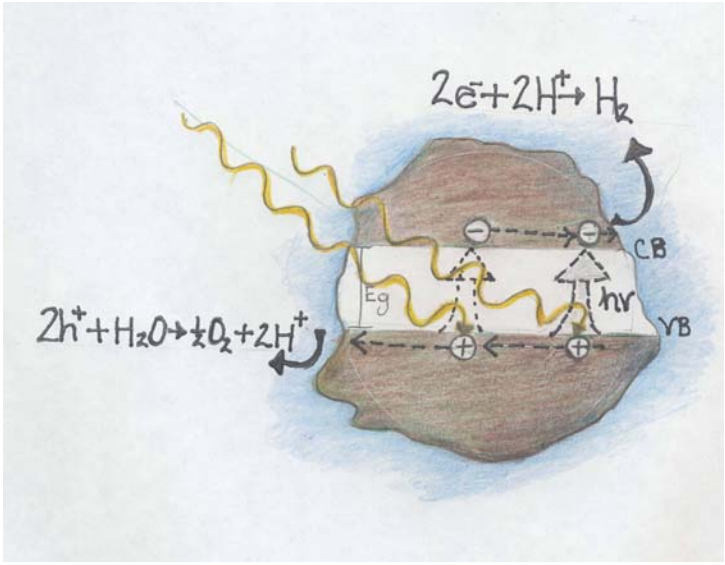
Photo-electrochemical water decomposition



- Both oxygen and hydrogen are collected separately

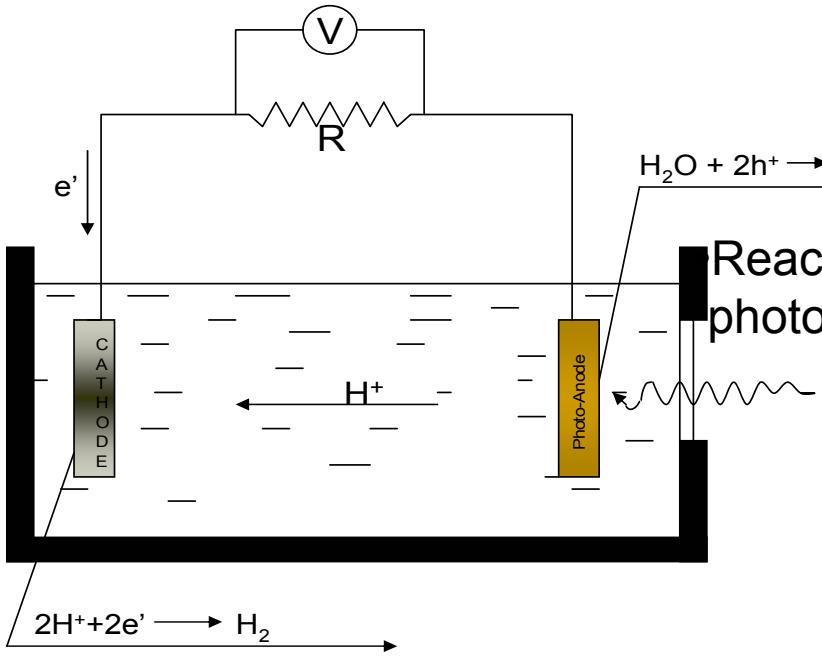
Photocatalytic materials for hydrogen synthesis

Photo-catalytic water decomposition



- Oxidation and Reduction occur on the surface of the photo-catalyst

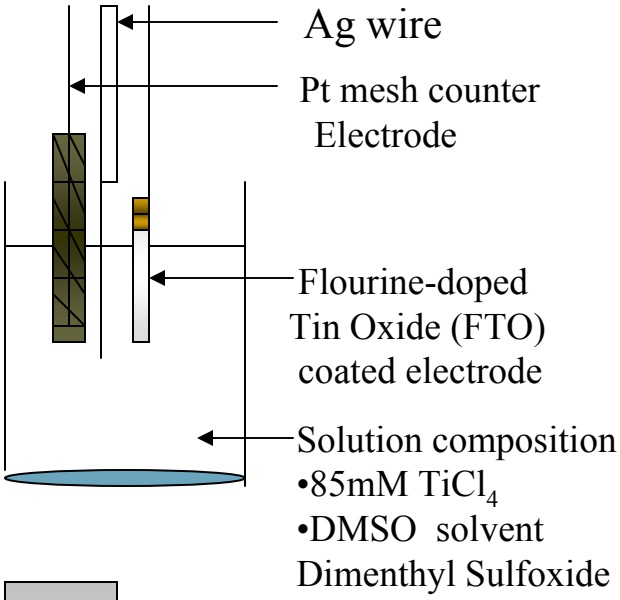
Photo-electrochemical water decomposition



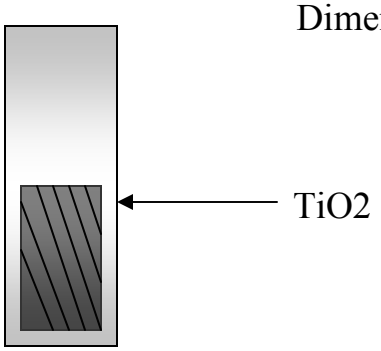
- Reactions take place at the photo-anode and cathode

Electrochemical deposition of titanium dioxide of (TiO_2) thin films

- Electro-deposition of titanium dioxide



- Crystallize sample at 450°C for 4 hours



- Photocurrent Testing

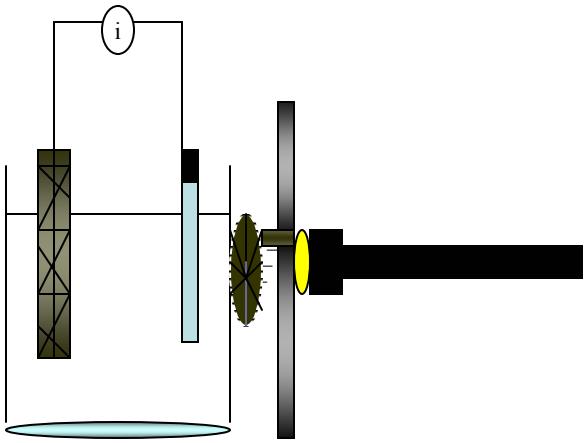
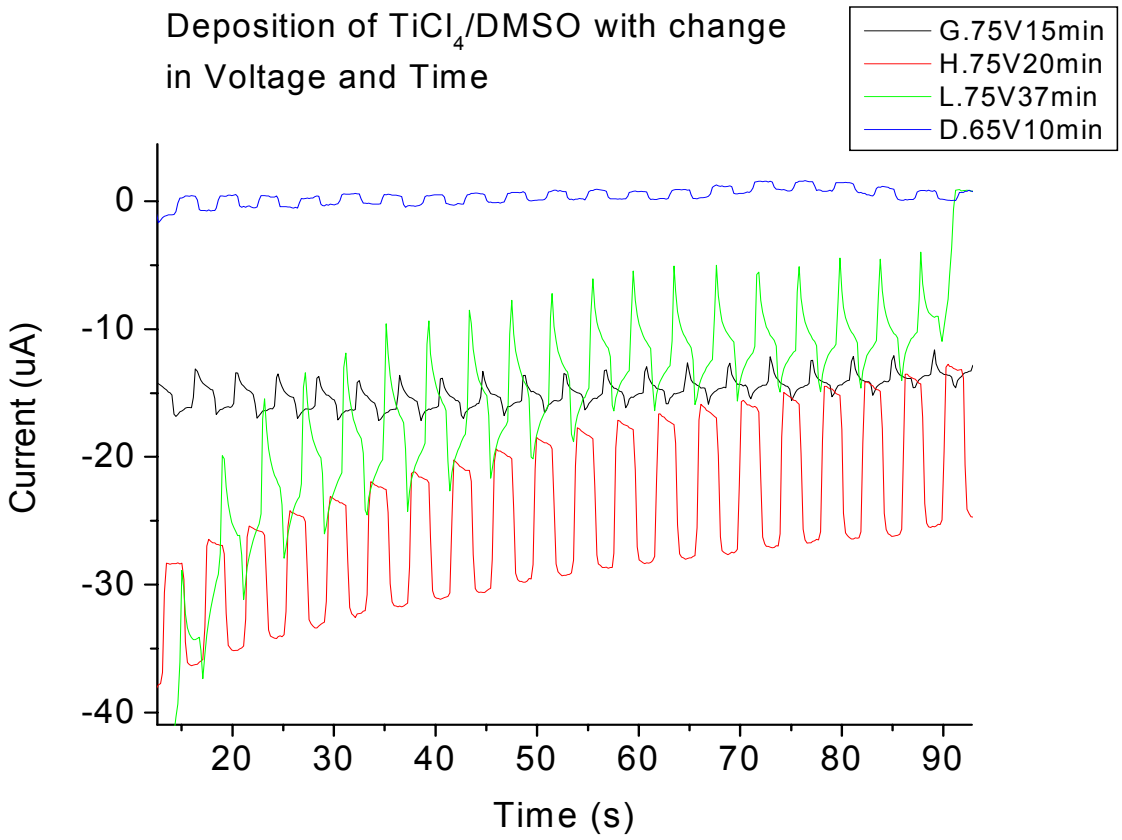
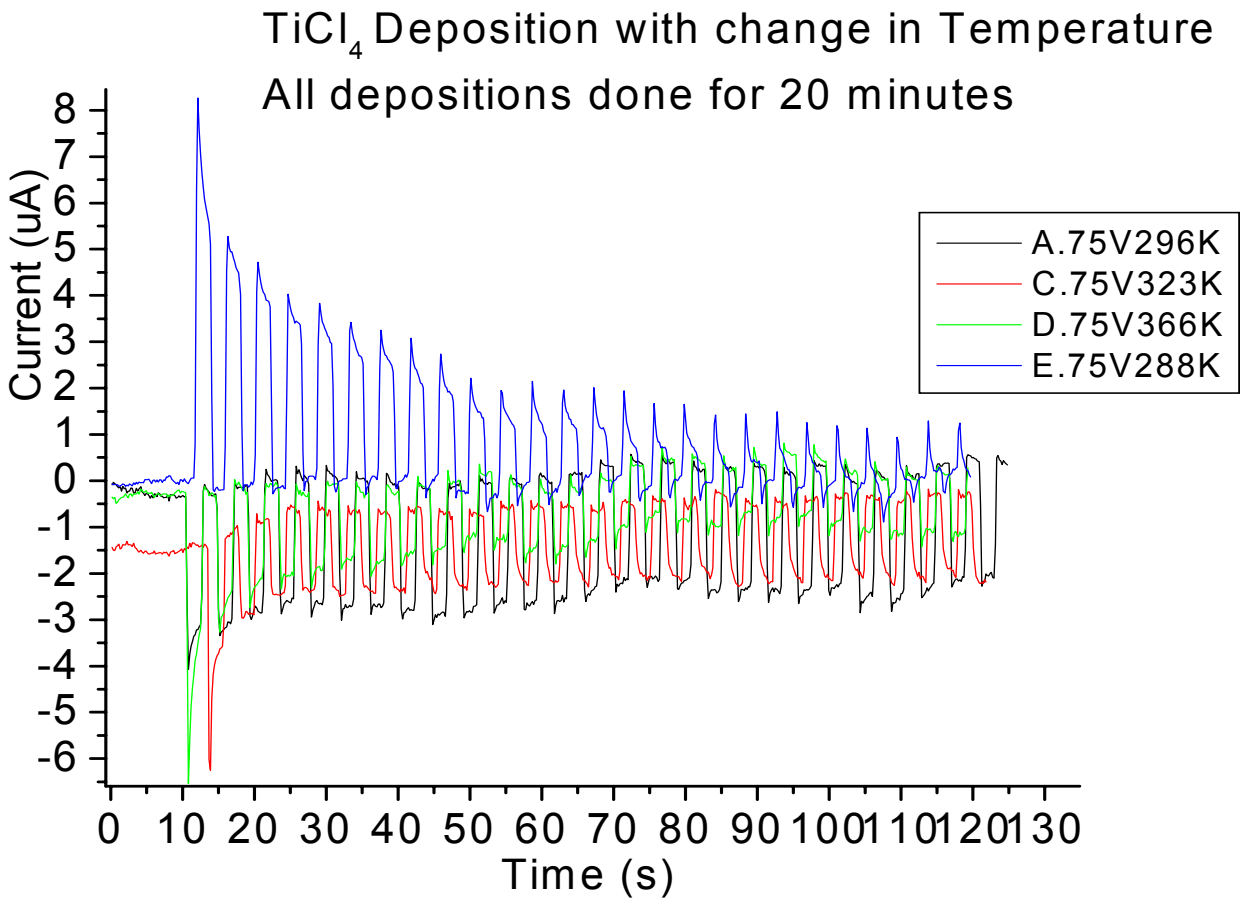
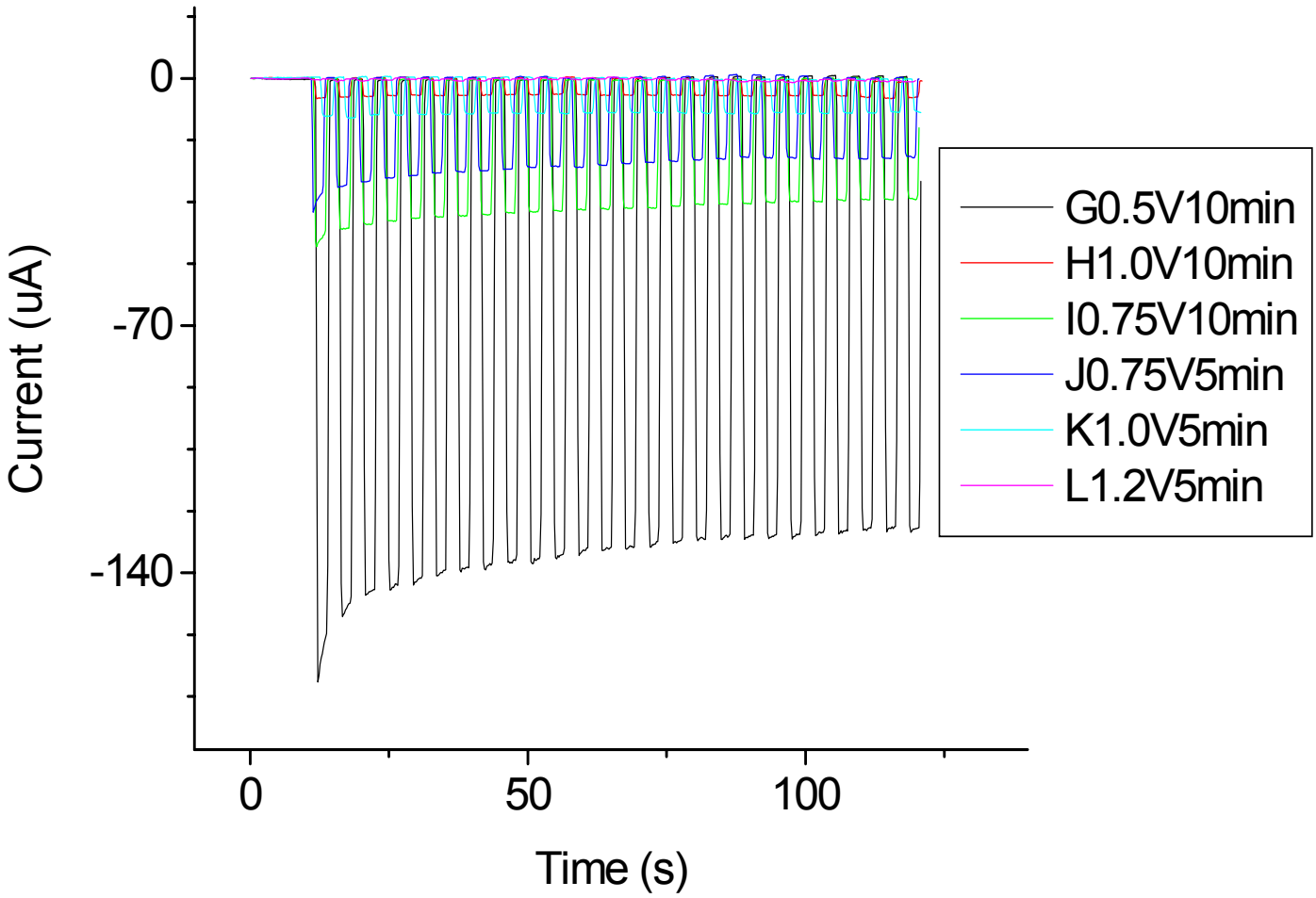


Photo-current Test results 7/18/03



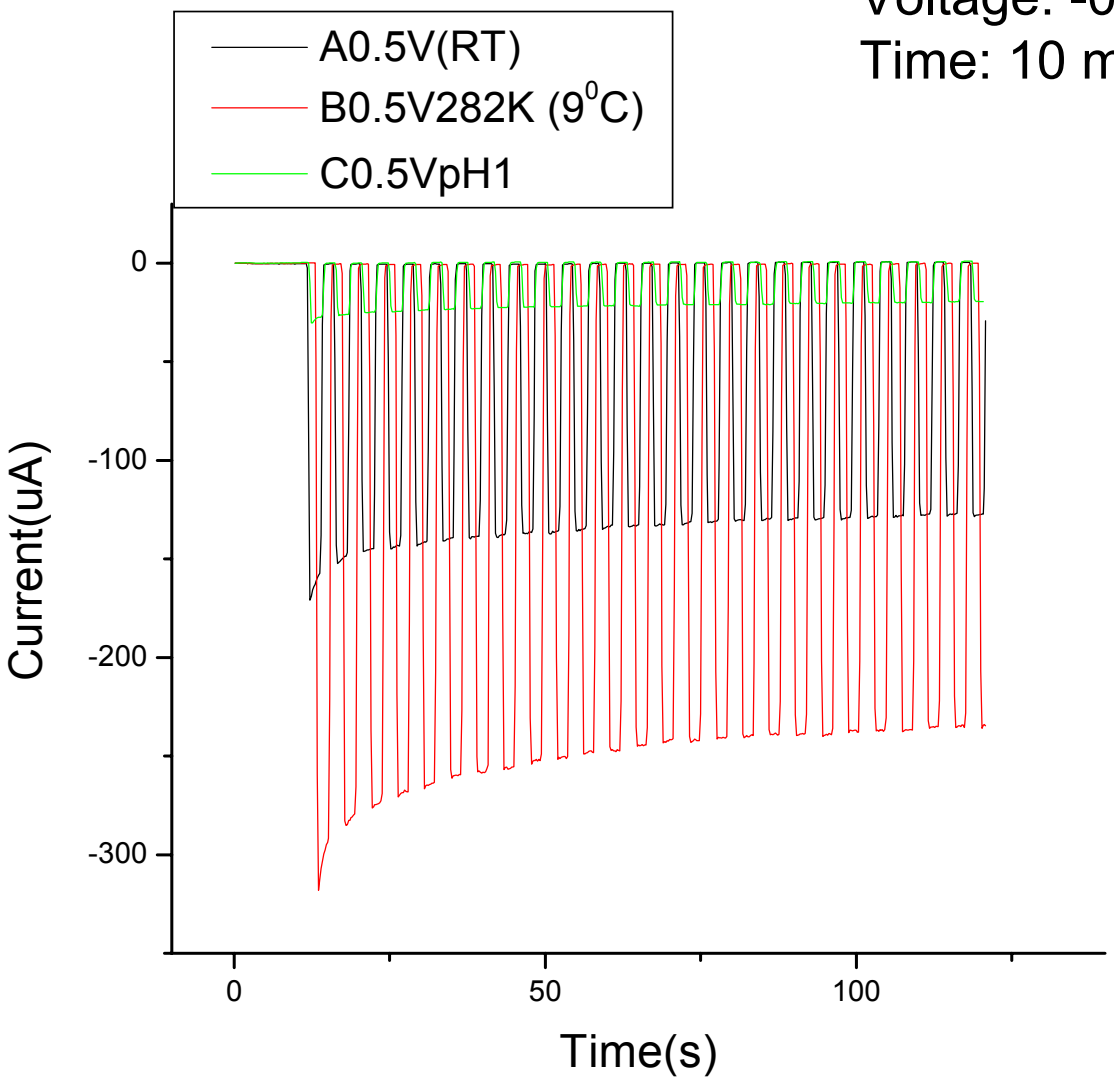


Ti-ethoxide Deposition
Constant Temperature (RT)

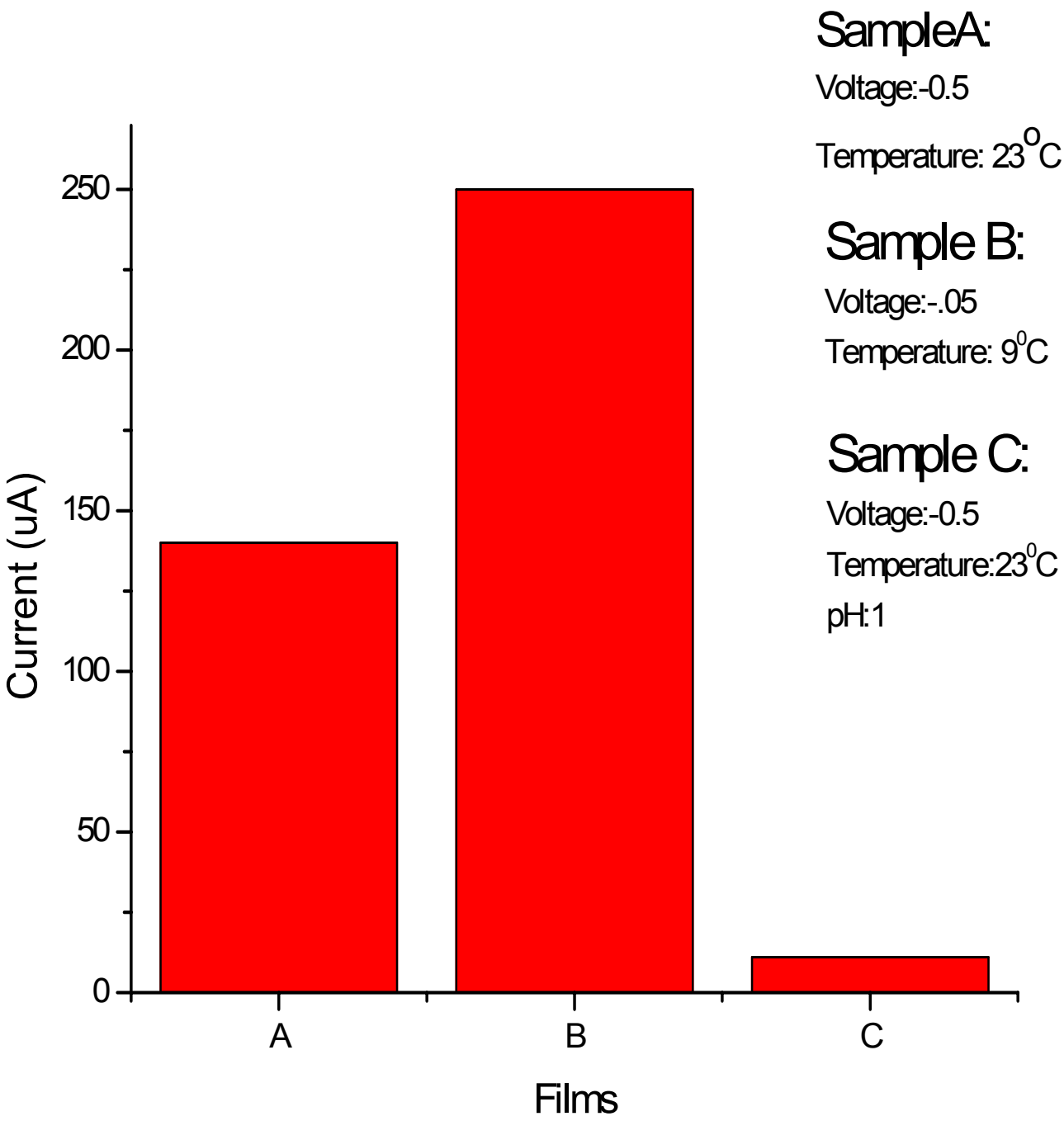


Ti-ethoxide Deposition

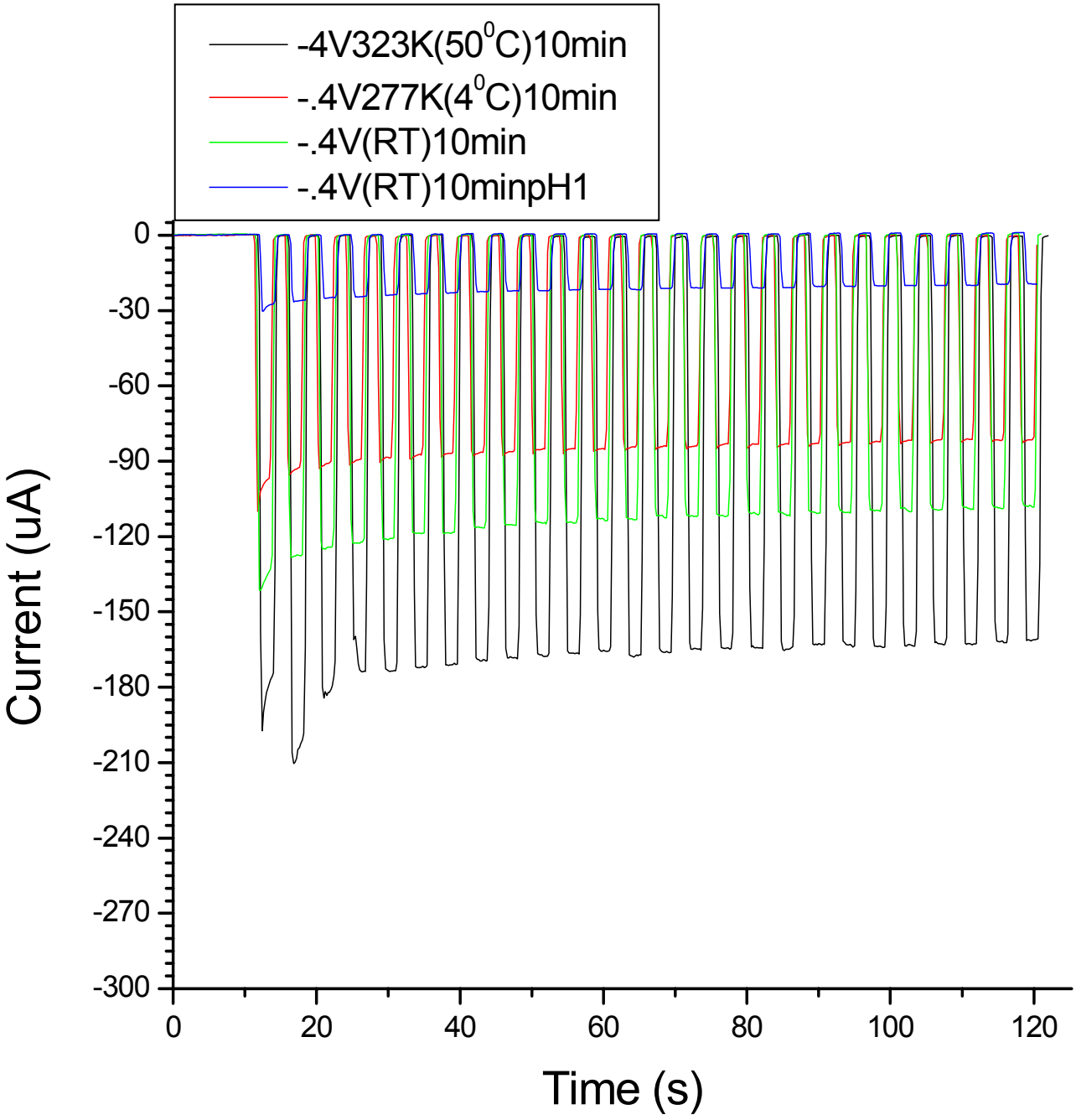
Voltage: -0.5V
Time: 10 min



Ti-ethoxide deposition



Ti-ethoxide Deposition with varying parameters



Conclusion:

• Ti-ethoxide deposition solution is superior to $TiCl_4$/DMSO in producing TiO_2.

Future Plans:

- To repeat and continue experiments for TiO_2 deposition from Ti-ethoxide solution
  - Explore -0.5,-0.4 Voltage changing different parameters:
    - Time
    - Temperature
    - Concentration
    - Bubbling Oxygen

The goal is to obtain high quality TiO_2 films. If we are successful, the next step is to use combinatorial chemistry to dope TiO_2 with various transition-metals in order to modify its bandgap and improve its solar energy absorption.