Lab 8: Dye Sensitized Solar Cells
Section U
Group 2

List of Materials:

Part 1: The Dye-Sensitized Solar Cell

Preparing the Electrode

- TiO_2 Paste

Dying the Electrode

- Blackberries
- Water
- Glass

Preparing the Counter-Electrode

- Carbon

Assembling the DSSC

- Liquid Iodide/Iodine solution

Testing DSSC

- DSSC

List of Equipment:

Part 1: The Dye-Sensitized Solar Cell

Preparing the Electrode

- Scotch tape
- Furnace
- Pipette
- Glass stir rod
- DI Water
- Ethanol
- Lint-free wipe
- Multimeter

Dying the Electrode

- Coffee Filter
- Watch Glass
- Mortar and pestle

Preparing the Counter-Electrode

- Candle
- Lighter
- Multimeter
- Tongs

Assembling the DSSC

- Binder clips

Testing DSSC

- Multimeter
- Desk Lamp

Part 2: The Silicon Solar Cell

- Commercial Silicon Solar Cell
- Multimeter
- Desk Lamp
- Dial Caliper

Detailed Procedure:

Part 1: The Dye-Sensitized Solar Cell

Preparing the Electrode

- Preheat lab furnace to 450ºC and acquire two glass slabs that are coated with tin oxide on one side
- Clean both slides with ethyl alcohol, and gently dry using a lint-free wipe
- Using the clear scotch tape, mask off about 3 mm of the glass slide on each of three sides
- Slide should be secured to the table using scotch tape, with ample exposure for TiO_2 paste
- With a disposable pipette, drop 3 small drops of the white nano-TiO_2 paste at the base of the moat
- Using a glass stir rod, lightly cover the electrode in an even coating
- After about a minute of air drying, a hair dryer can be used to complete drying process
- Once the slide is dry, remove the tape from the edges of the sample
- Sinter the film by, carefully placing the slide into the furnace at 450ºC
- Set a timer for 30 minutes and continue with the following steps once 30 minutes passes
- Remove electrode and place it on heat resistant tile to cool for about 5-10 minutes

Dying the Electrode

- Place 2 blackberries into a small bowl and crush with a fork
- Add about 1-2 ml of water to the bowl and crush again to mix
- Pour the berries and liquid into a coffee filter (dampen filter first) and collect dye in a bowl
- Pour the collected dye into a watch-glass
- Gently place the sintered Titania-coated electrode face down into the watch glass
- Ensure the entire Titania film is in contact with the dye
- Allow the slide to soak for 5–10 minutes
- After 10 minutes have passed, carefully remove dye-stained TiO_2 covered electrode from watch glass
- Using the water bottle, thoroughly rinse the TiO_2 film several times over the waste beaker
- Rinse with the ethanol bottle and set it on the bench, allowing it to completely dry

Preparing the Counter-Electrode

- Take the other piece of glass and identify the side with the conductive FTO coating using a multimeter
- Pick up the slide with a pair of tongs and hold it (conductive side down) over a candle flame
- Slowly pass the slide through the outer yellow portion of the flame

Assembling the DSSC

- Place graphite coated slide face down on top of dry juice soaked TiO_2 coated side of second slide
- The slides should be placed slightly offset to allow enough room on the end to place an alligator clip
- Use two binder clips to hold the two slides together
- Using a disposable pipette, place 1-2 drops of liquid Iodide solution on crease between two slides
- Alternate releasing the binder clips, one at a time, to facilitate capillary action

Testing DSSC

- Positive terminus of multimeter to graphite covered counter electrode and negative to FTO electrode
- When the circuit is complete, position the DSSC centrally under the lamp

- Turn on the lamp and record the stabilized voltage, V_{sc}
- Finally measure and record current of the DSSC by turning the multimeter switch to mA
- Measure and record the active area of the DSSC
- Record any observations

Part 2: The Silicon Solar Cell

- Connect the positive (red) and negative (black) terminals to the multimeter using the alligator clips
- Set the multimeter knob to the scale for V_{DC}
- Position the silicon solar cell centrally under the lamp
- Turn on the lamp and observe until a stable voltage reading is reached
- Once the reading has stabilized, document the voltage (This is the open circuit voltage of the cell)
- With the lamp still on, set the multimeter to test the current of the silicon solar cell
- Record the current. This is the short circuit current of the cell
- Turn the lamp off and flip the solar cell face down (What happens to voltage and current output of cell?)
- Measure the active area of the silicon solar cell. Record the area on the provided worksheet

Results and Observation:

Commercial Solar Cell

Open-Circuit Voltage (V)	6.15
Short-Circuit Current (mA)	5.36
Active Area (in^2)	(0.184 in [width])•(0.908 in [length]) = 0.168
Observations	As the light source gets closer, current increases. Voltage stays the same, due to electric-potential being unchanged without altering physical characteristics, such as doping concentrations in the silicon layers. *Desk Lamp Current: 5.36 mA* *Room Light Current: 0.13 mA* *Phone Light Current: 0.28 mA*

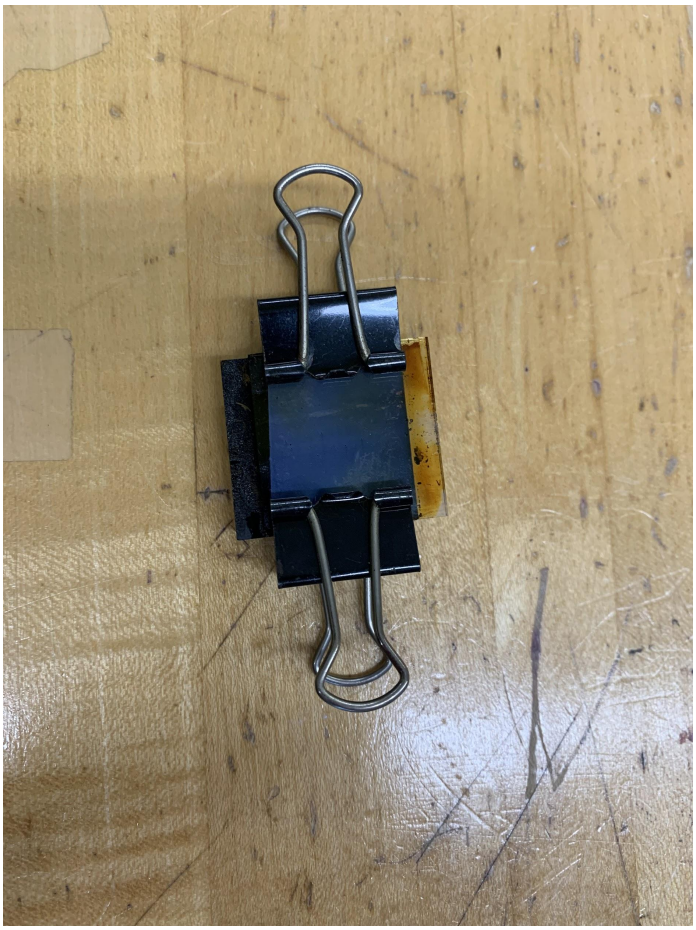
Dye-Sensitized Solar Cell

Open-Circuit Voltage (mV)	151.3
Short-Circuit Current (µA)	18
Active Area (in^2)	(0.633 in [width])•(0.823 in [length]) = 0.521
Observations	Dye-soaked layer turns purple Carbon-coated layer turns black Should be around 200 mV, our max was 151.3 mV. Averaged out around 14.4 mV. *Desk Lamp Current: 0.018 mA*

	Sunlight Current: 0.010 mA *Sunlight Voltage: 3.5 mV*

Notes

- Air-dried TiO_2 coated glass slab is placed in the oven to coarsen the TiO_2 layer. Prior to this, there is a separation in between the glass and TiO_2 layer, which prevents electrons from transporting.
- Capillary action allows electrolyte solution to evenly disperse between the two layers



The DSSC

Signature:
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