Potentiostat User Manual

Table of Contents

Technologies

Hardware

1. Potentiostat as described in Fa-Yuan Wang's 2019 thesis titled: Investigation into the Effect of Metal Doping on the Photocurrent Response of g-C_3N_4 (see Chapter 3)

2. Electrochemical Cell→ For photocurrent experiments, a specially designed beaker with a quartz window can be purchased from Aida in Tianjin, China (see below). Otherwise, a beaker appropriately sized for the experiment can be used.

3. Three electrodes:
    a. Working electrode
    b. Auxiliary electrode (platinum mesh is commonly used)
    c. Reference electrode (SHE or SCE is commonly used. An SCE reference electrode can be purchased from Aida in Tianjin, China.

4. Banana plugs connected to alligator clips

5. (Optional) Metal electrode holders can be purchased from Aida in Tianjin, China (see below).

Software

1. Arduino:
    a. Arduino IDE (can be downloaded at: https://www.arduino.cc/en/main/software)
    b. Wire Library (how to install Arduino libraries: https://www.arduino.cc/en/guide/libraries)
    c. Adafruit_MCP4725 Library (how to install Arduino libraries: https://www.arduino.cc/en/guide/libraries)

2. Python:
    a. Python version: 2.7 (can be downloaded at: https://www.python.org/downloads/; would recommend downloading Anaconda/Spyder which comes with an IDE and pre-installed packages: https://www.spyder-ide.org/)
    b. NumPy Library version: 1.15.3 (can be found here: https://www.numpy.org/; or if Anaconda/Spyder downloaded NumPy is already installed)
    c. PySerial Library version: 3.4 (can be found here: https://pypi.org/project/pyserial/; note that this library still needs to be manually installed even if Anaconda/Spyder was downloaded)

Set-Up

1. Set up the electrochemical cell by placing the electrodes in the beaker with electrolyte solution, ensuring the electrodes are not completely submerged.

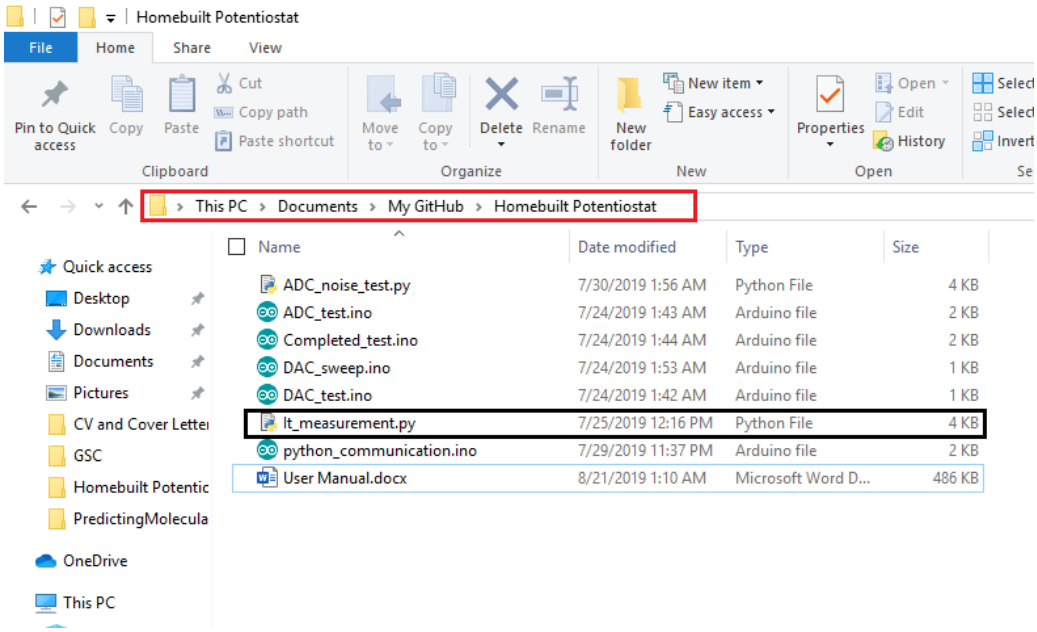
2. Clip the alligator clips onto the electrodes (or electrode holder) and plug the banana plug into the circular banana jacks found on the potentiostat. The working electrode should be connected to the red banana jack, the auxiliary electrode connected to the black banana jack, and the reference electrode to the green banana jack.

3. Connect the wall adaptor to any outlet. Plug the USB into a computer with the software described above pre-installed.

4. Upload the ‘python_communication.ino’ program using the Arduino IDE (note: this only has to be done once. Do this step if you: a) have not used the potentiostat at all before or b) if you have uploaded another Arduino program into the potentiostat. Otherwise, you can skip this step).

Perform Photocurrent Measurement

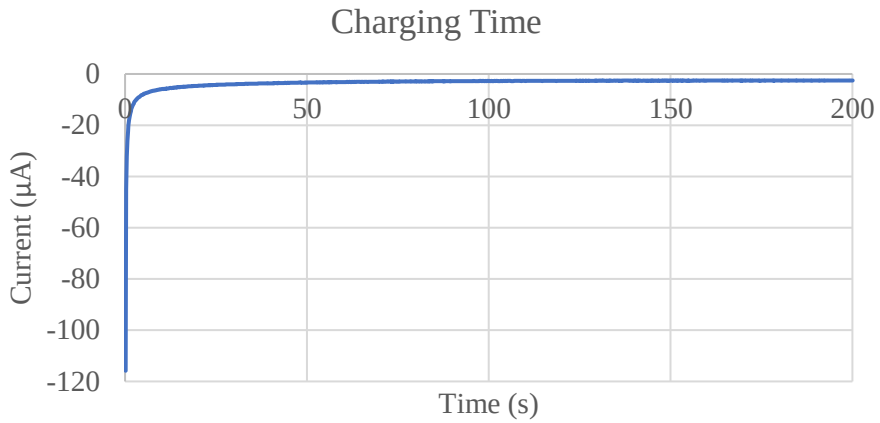
1. To perform a photocurrent measurement, run 'It_measurement.py'. If clicking on the file does not work, either open it from the Spyder IDE (if you have downloaded it) or run it from the command prompt (instructions below for how to use the command prompt on a Windows computer):
    a. From search menu, open 'command prompt'
    b. Go to the directory the file is located in by using the 'cd' command eg. In the below case:



    type into the command prompt: 'cd Documents\My GitHub\Homebuilt Potentiostat' and then press enter

    c. Run the program by typing in the file name eg. 'It_measurement.py'

2. After successfully running the program, you will be given a series of inputs. They are as follows:
    a. DAC Value → Enter the potential you would like to apply to the system. IMPORTANT: the input is in bits so if you want a potential of 0V, enter 2048. If you want a potential of +10V, enter 4096 (see thesis section equation 3.6 for equation converting Volts to bits)
    b. File Name → Enter the filename you would like to save the data to. The filename should end in .txt or .csv. If the filename already exists in the directory, the program will not run.
    c. Wait Time (s) → Enter how long you would like to wait for the system to equilibrate after applying a potential. If a wait time is not used, you may have an exponential baseline in your curve as seen below:



d. Scan Rate (s-1) → Enter the rate at which the potentiostat will take current measurements. Note that in 'python_communication.ino' there already exists a small 50ms delay which will affect the scan rate.
e. Run Time (s) → Enter how long you would like to run the measurement for.

3. Press enter and the program will begin. The potentiostat will apply the specified potential and let the system equilibrate for the specified wait time before measuring the current. When the time (in seconds) begin showing in either the command terminal or the Spyder IDE, measuring has begun. During this time, periodically cover and uncover the light source to obtain a photocurrent measurement.

4. Once the program finishes, you can plot the data using whatever graphical software you are comfortable with. To ensure there is no sudden changes in applied potential, please unplug the potentiostat from the wall and the computer before removing the alligator clips from the electrodes.

5. Congratulations! You completed a photocurrent measurement.