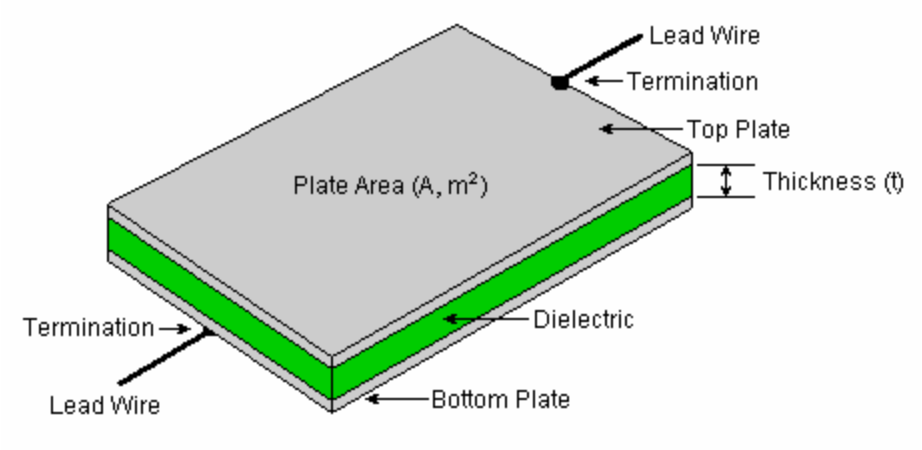
Electropolymerization of Aniline on Platinum electrodes for the Construction of a Symmetrical Electrochemical Supercapacitor

By: Nyeemah Kennedy
Professor: Dr. Santiago
Mentor: Dr. Cardona

Supercapacitor

- Store energy and charge
- Electrical double layer with non-Faradic and Faradic charge in the electroactive polymer plates
- Made up of two plates (electrodes), and an electrolyte that serve as a charge carrying fluid, that lies between both plates to separate their charge.



http://sound.westhost.com/articles/capacitors.htm

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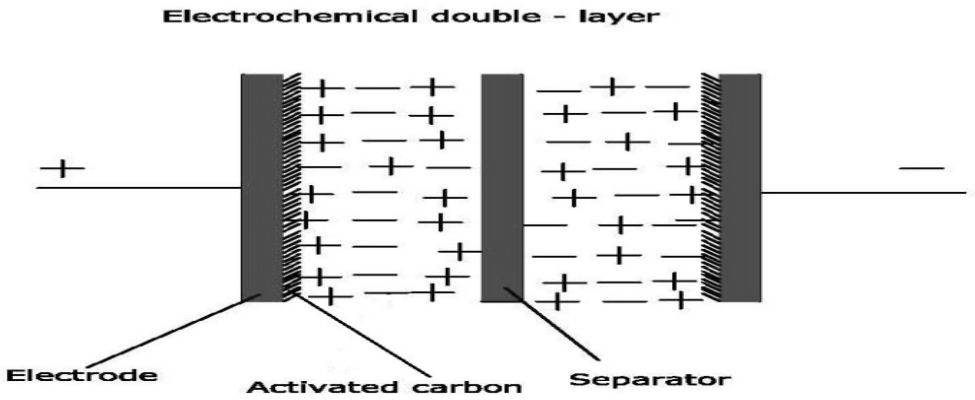
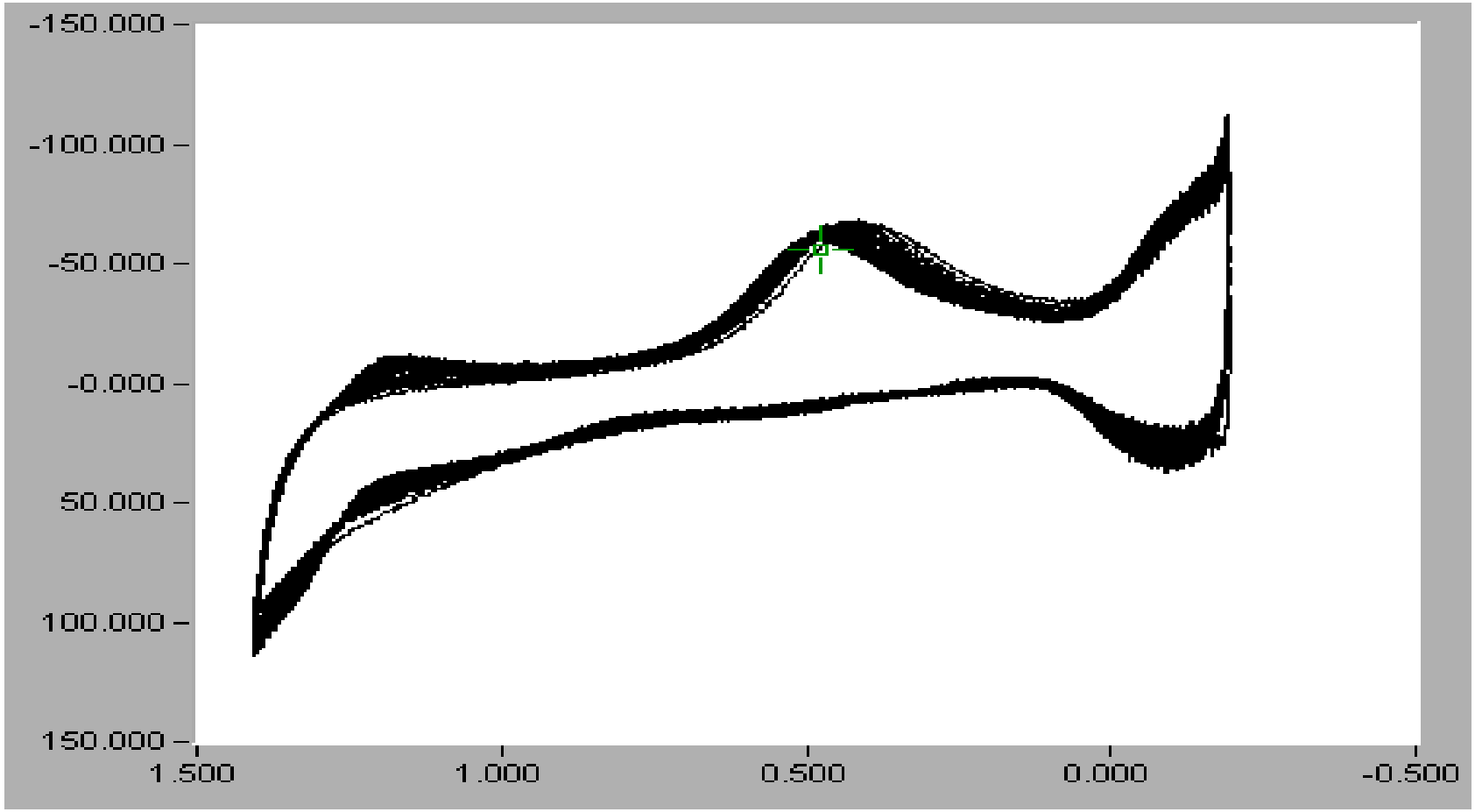
- Electrochemical capacitors are similar to normal capacitors in the sense that they have the same structural format but their plates are made up of either double layer capacitors(DLC) or electroactive polymeric substances.
- Some advantages of electrochemical- symmetric-capacitor over regular capacitors is that they can store more charge per unit voltage (larger capacity), they have higher energy density (W-h/ kg) and they can be charged and discharged quicker (higher power density).



Methods

- We have tested an electroactive compound aniline using a Biopotentiostat.
- We measured different sweep rates by scanning the potential of four platinum electrodes.
- We cleaned each of the four platinum electrodes with H_2SO_4 to eliminate any electroactive polymers that were left on the surface using the Biopotentiostat.

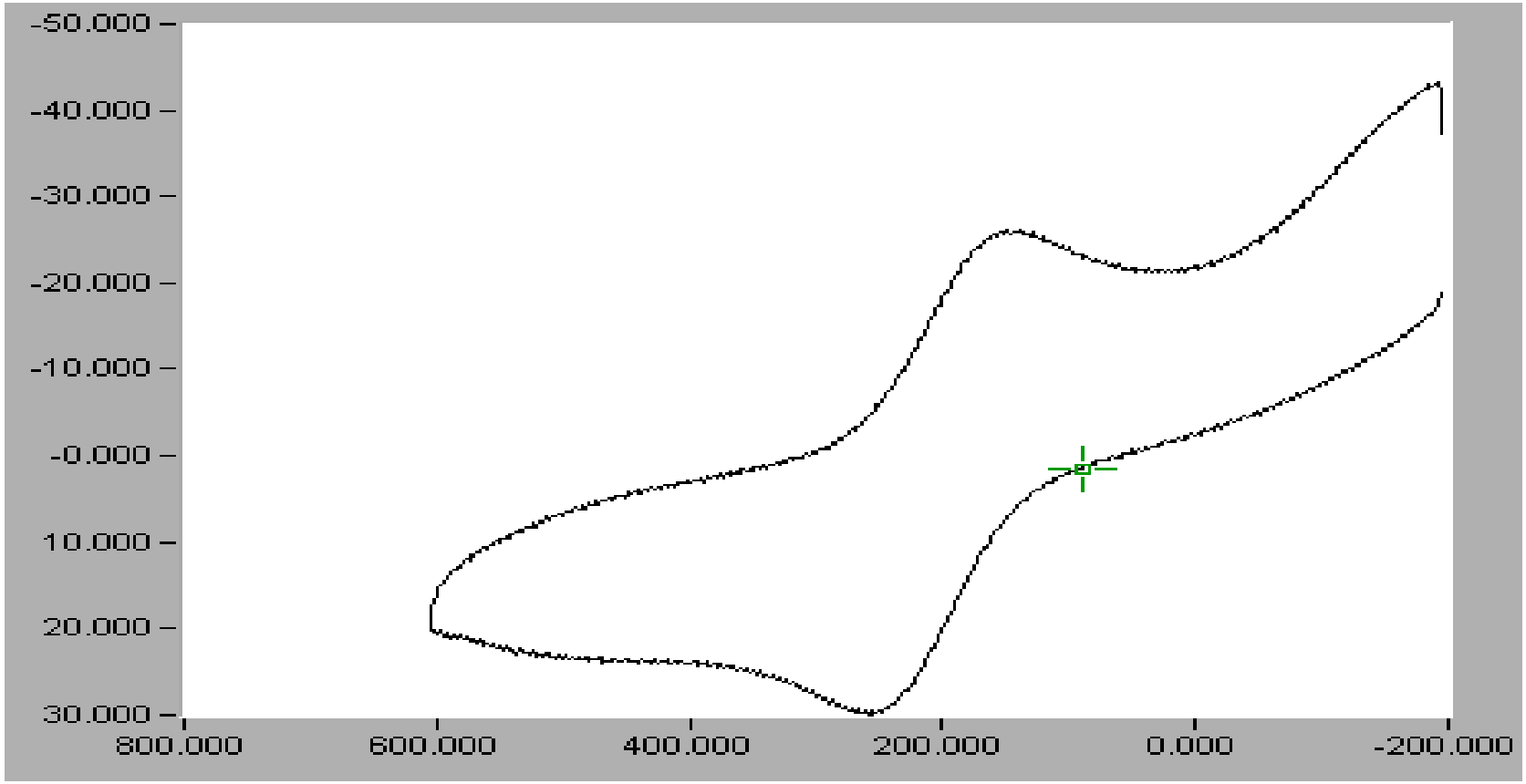
Cyclic Voltammetry for 0.50 M H_2SO_4 at 100 mV/s (20 cycles)



Electrode Area Determination

- $K_3Fe(CN)_6$ was used as an standard for electrode area determination
- The area of the electrodes was determined from chronoamperometry graph (Current vs 1/sqrt T (Cotrell Plot)) and Cotrell Equation
- $it^{1/2}=nFAD^{1/2}C_o^*/\pi^{1/2}$
- $m=it^{1/2}=amp=C/s$

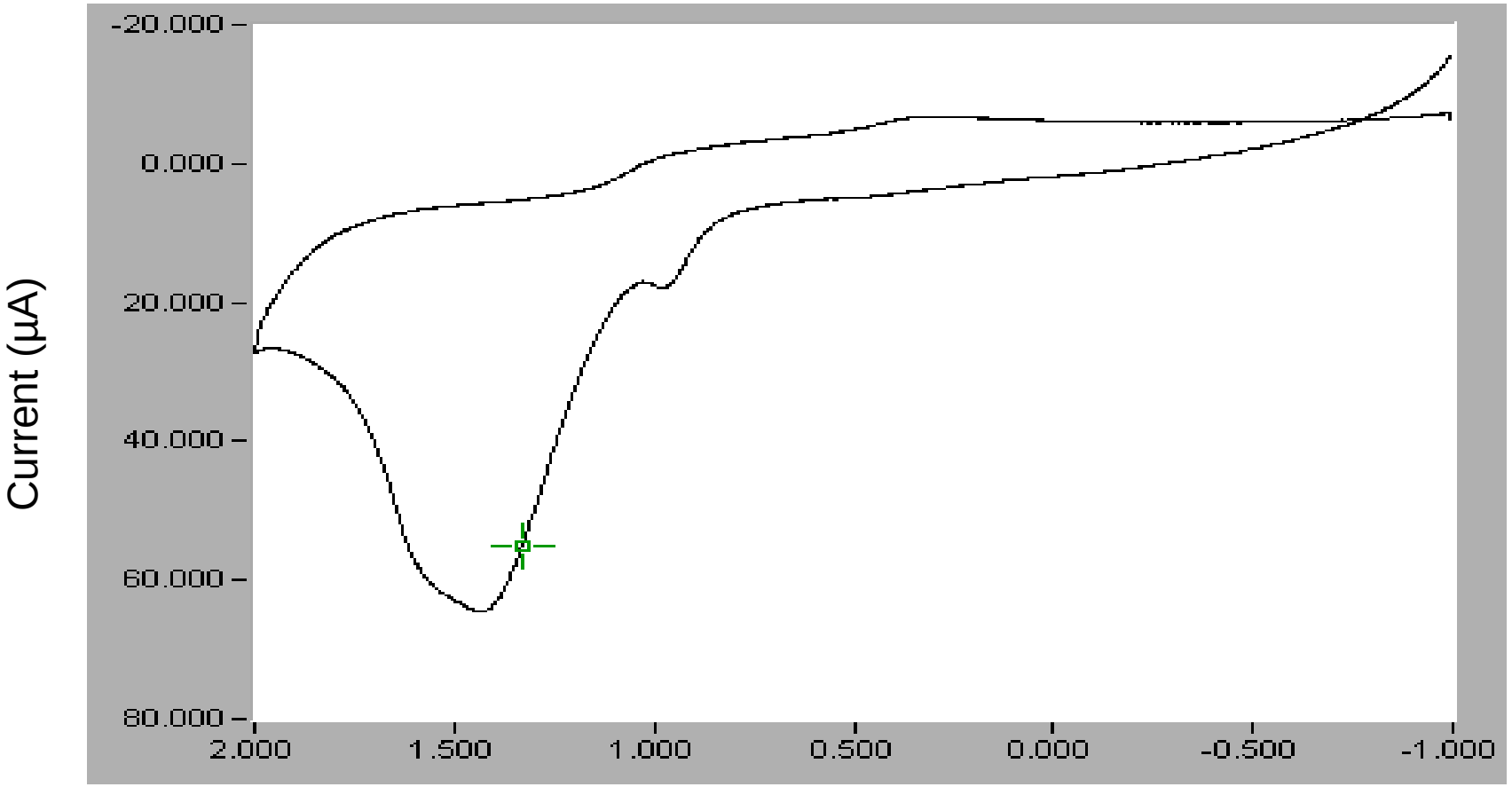
Cyclic Voltammetry for 0.001M $K_3Fe(CN)_6$ in 0.1M KCl/water at100 mV/s (1 cycle)



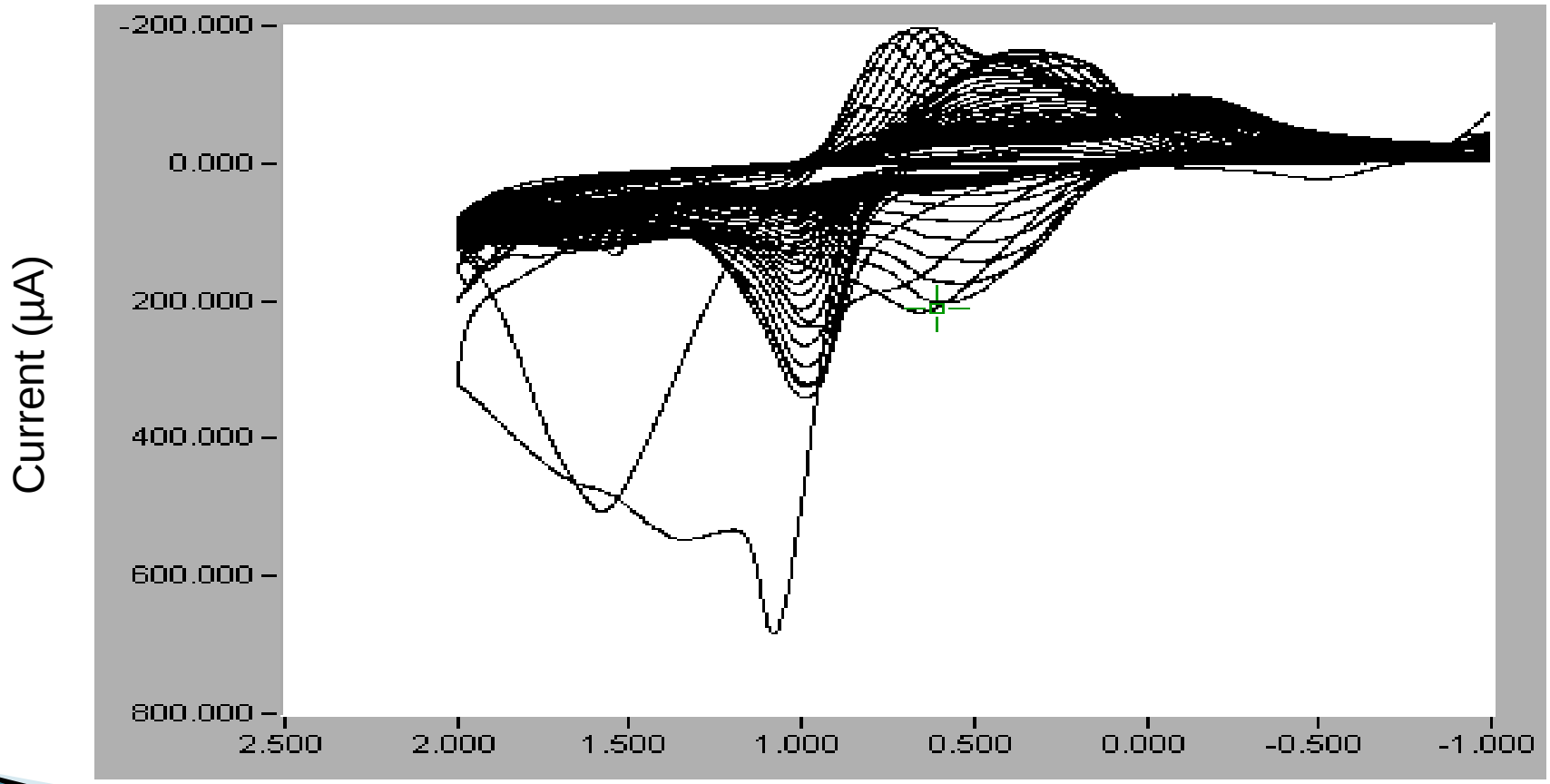
Current (µA)

Potential, mV vs. Ag/AgCl (3 M NaCl)

Cyclic Voltammetry for 0.01M Aniline in 0.1M TBAP/Acetonitrile at 50 mV/s (1 cycle)



Cyclic Voltammetry for 0.01M Aniline in 0.1M TBAP/Acetonitrile at 50 mV/s (50 cycles)



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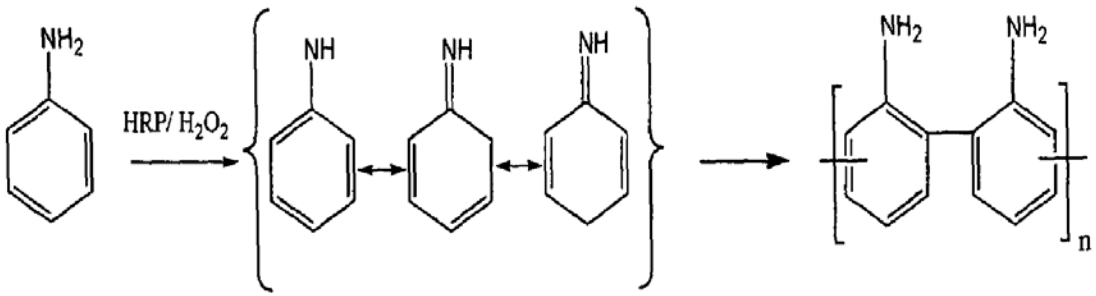
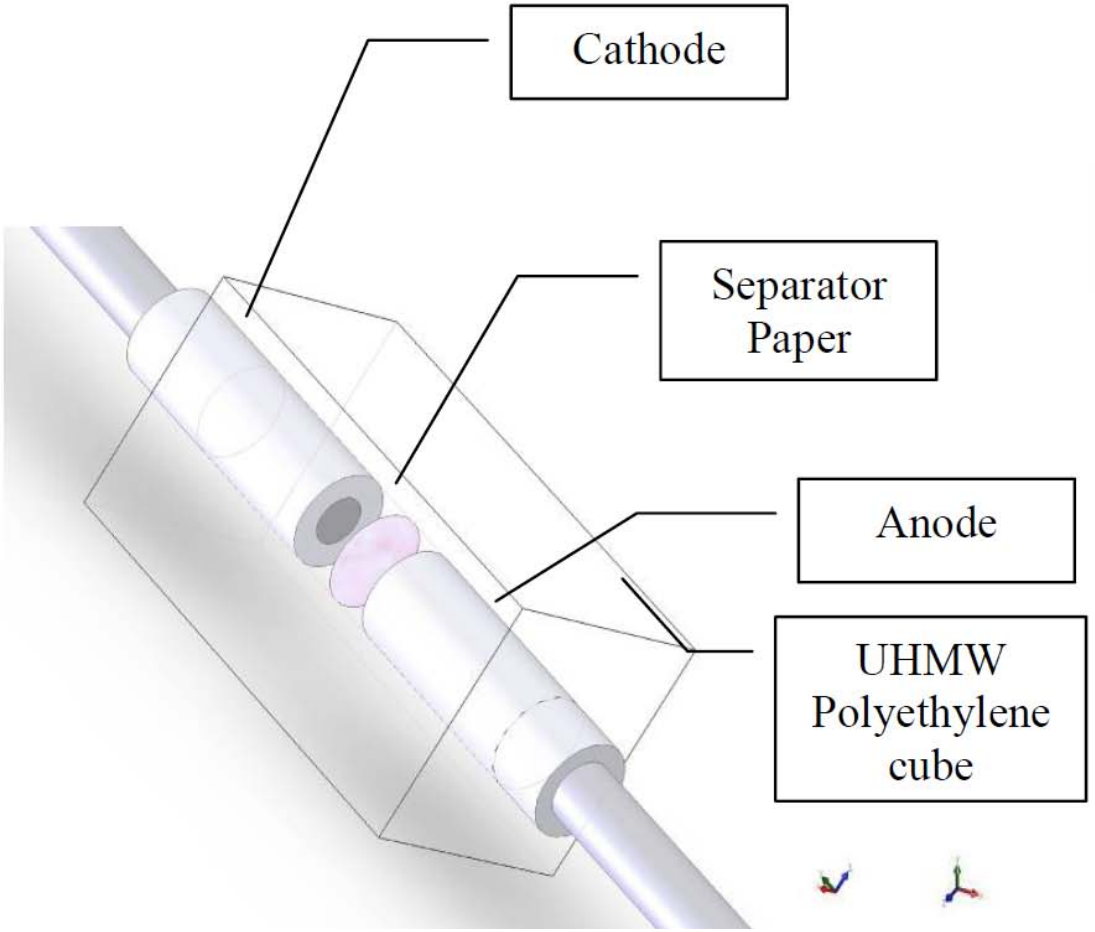
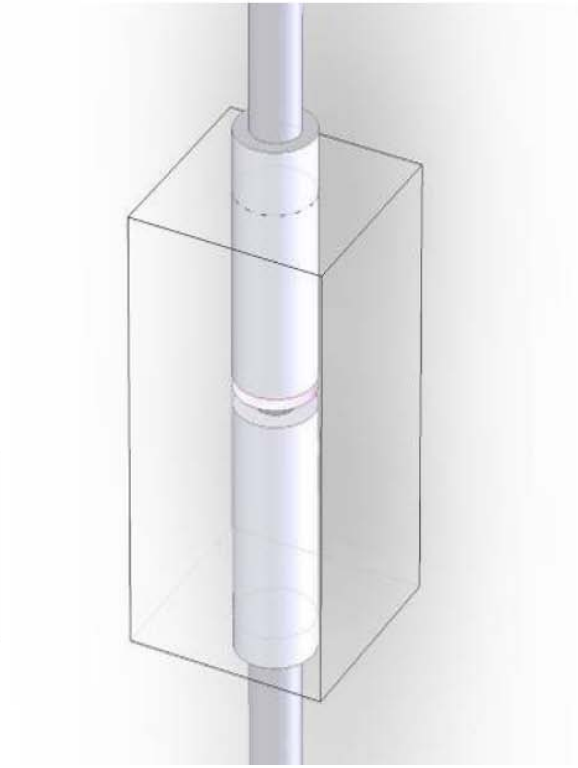
- Used the monomer Aniline for Electropolymerization to the polymer poly-aniline using the Biopotentiostat
- A thin black film of aniline was left of the surface of the electrodes



http://www.freepatentsonline.com/7056675.html

Supercapacitor Set-Up

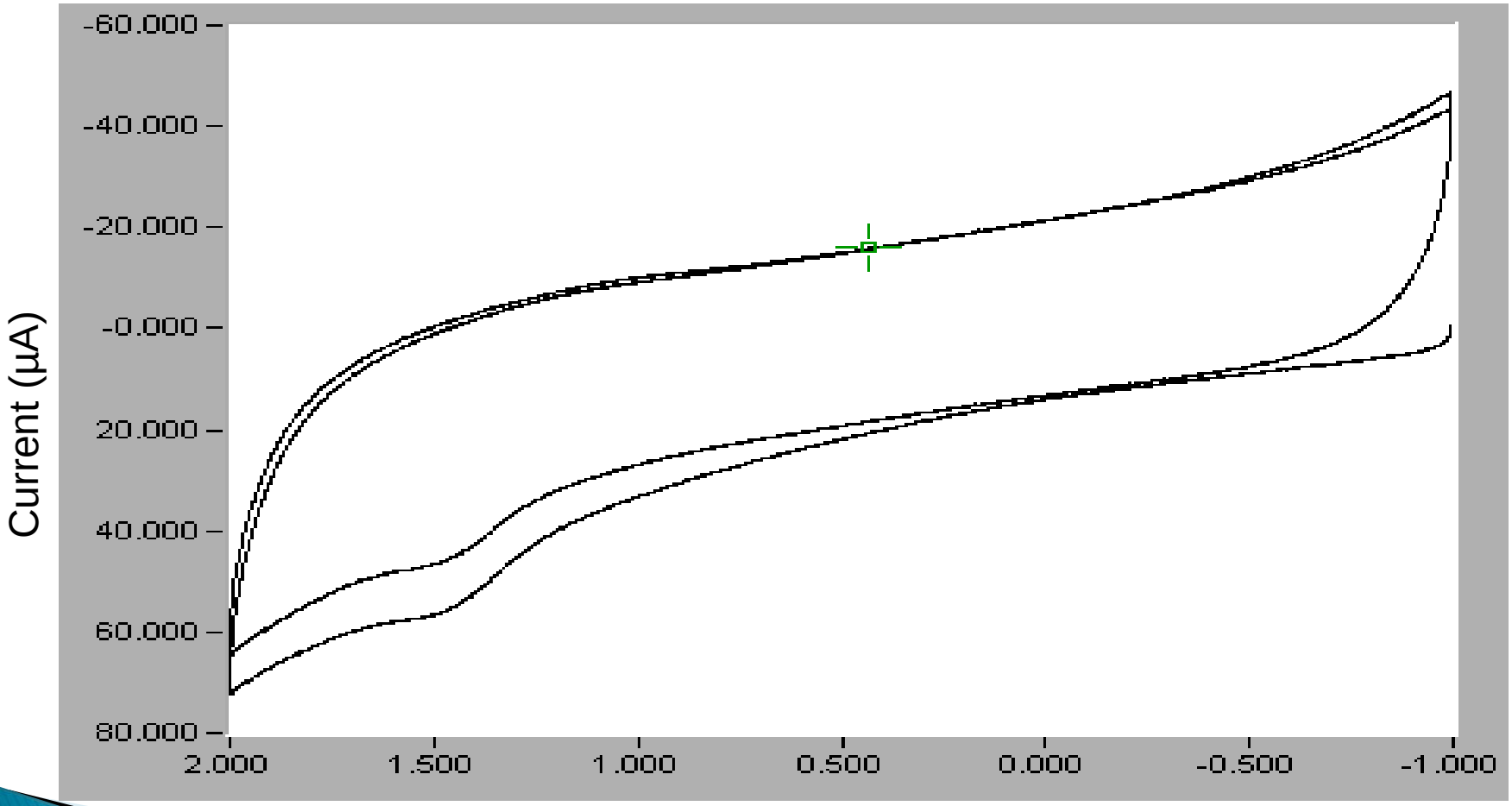




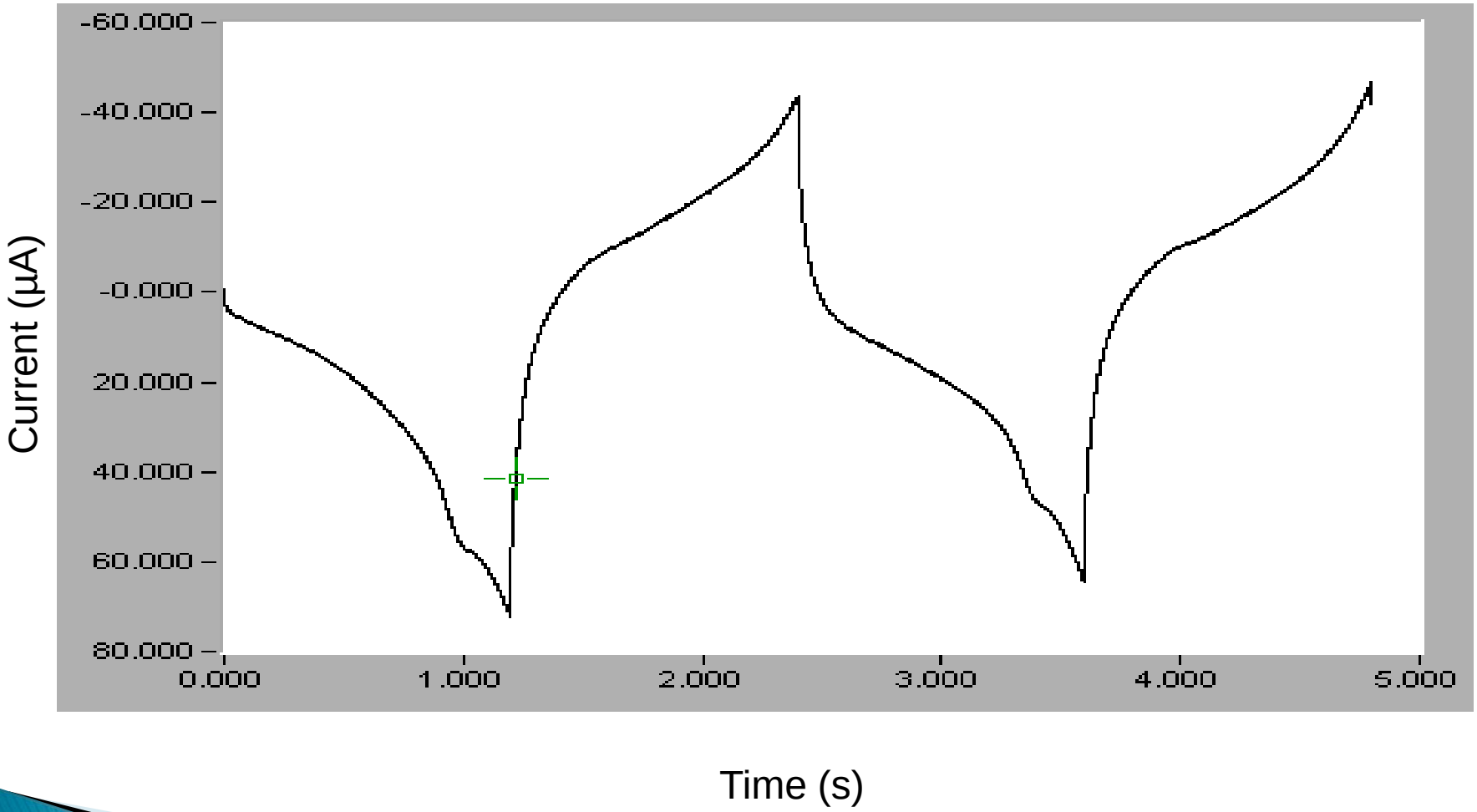
Results and Discussion

- The electropolymerization of aniline was shown to make a thin film on the surface of the electrodes at large sweep rates.
- Our research is on going trying to optimize the window potential and electrolyte conditions for poly aniline

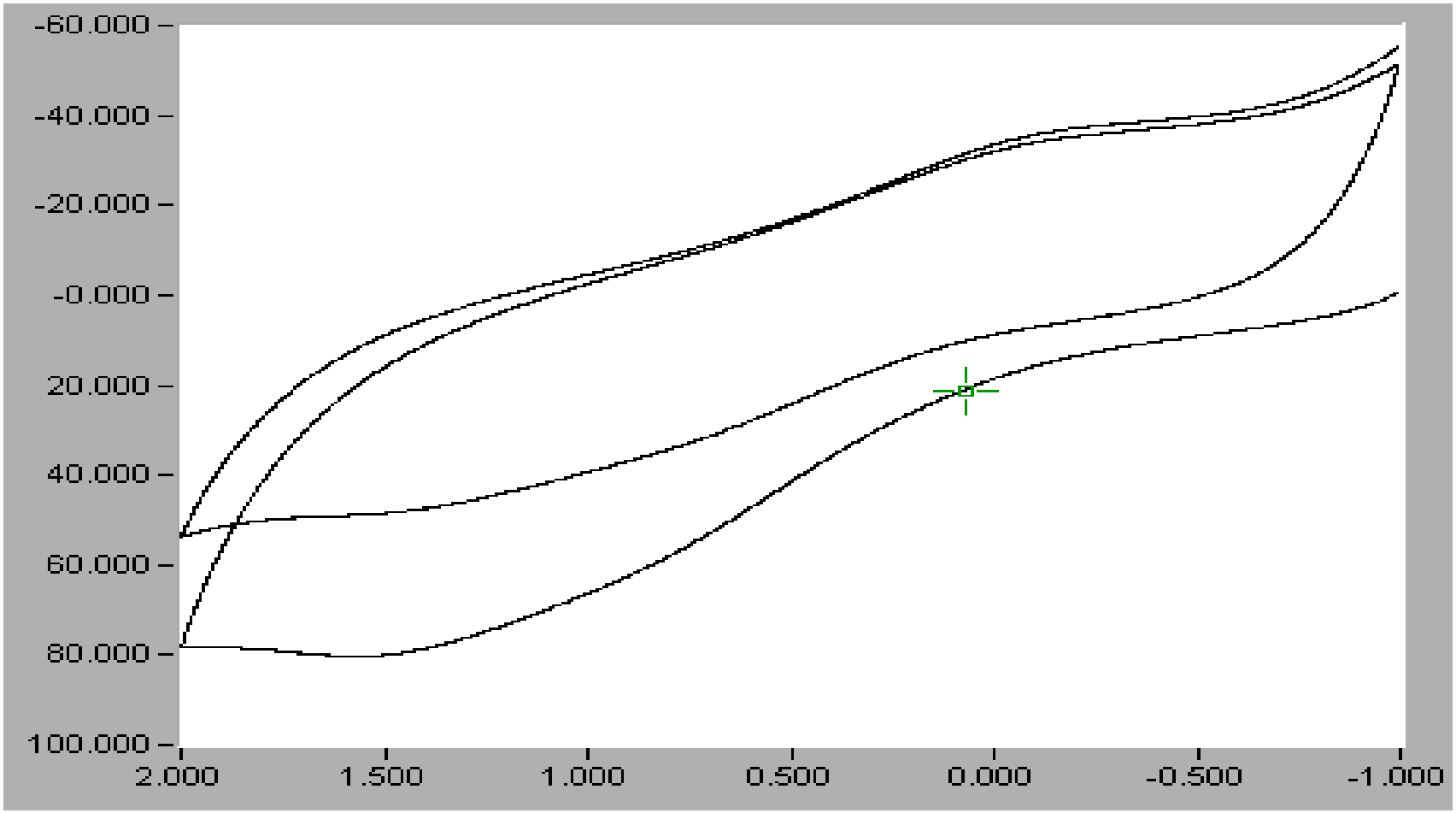
Cyclic Voltammetry for 0.1M TBAP in Acetonitrile [Supercapacitor] at 2500 mV/s (2 Cycles)



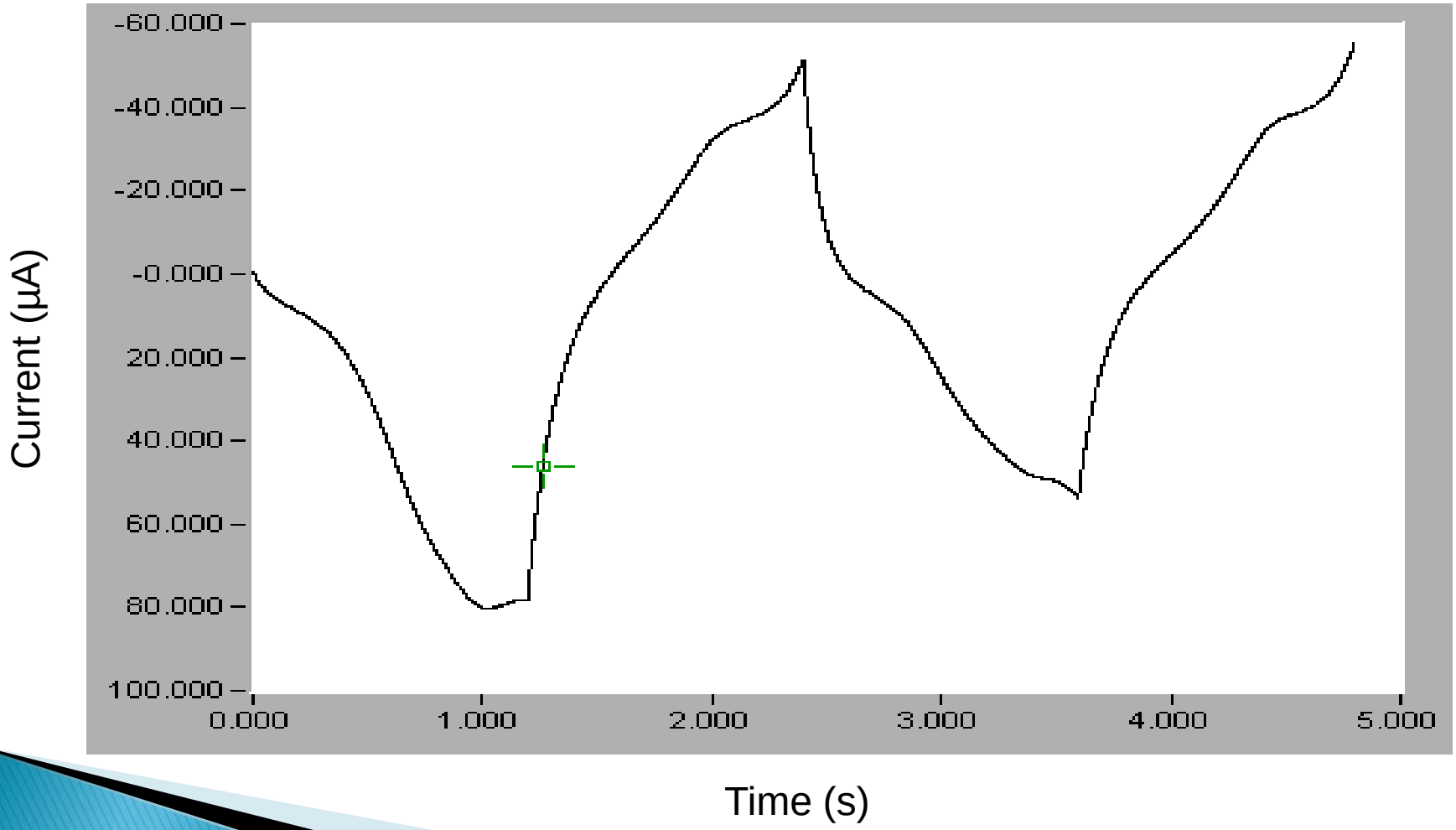
Current vs. Time for 0.1M TBAP in Acetonitrile



Cyclic Voltammetry for 0.01M Aniline in 0.1M TBAP/Acetonitrile [supercapacitor] at 2500 mV/s (2 Cycles)



Current vs. Time for 0.1M Aniline in 0.1M TBAP /Acetonitrile



Future Research

- We are trying to maximize the charge storage in our symmetrical supercapacitor by using a minimum amount energy.
- Plan to look for appropriate window for maximum energy exchange for aniline
- Plan to make an asymmetrical supercapacitor using carbon derived carbon and the polymer PProDot

Acknowledgements

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References

- [1] M. Jayakakshmi, K. Balasubramanian. (2008, Oct.). “Simple Capacitors to Supercapacitors-An Overview”. *International Journal of Electrochemical Science*. [Online] Vol. 3, pp. 1196-1217. :www.electrochemsci.org. [Accessed June 1, 2011]
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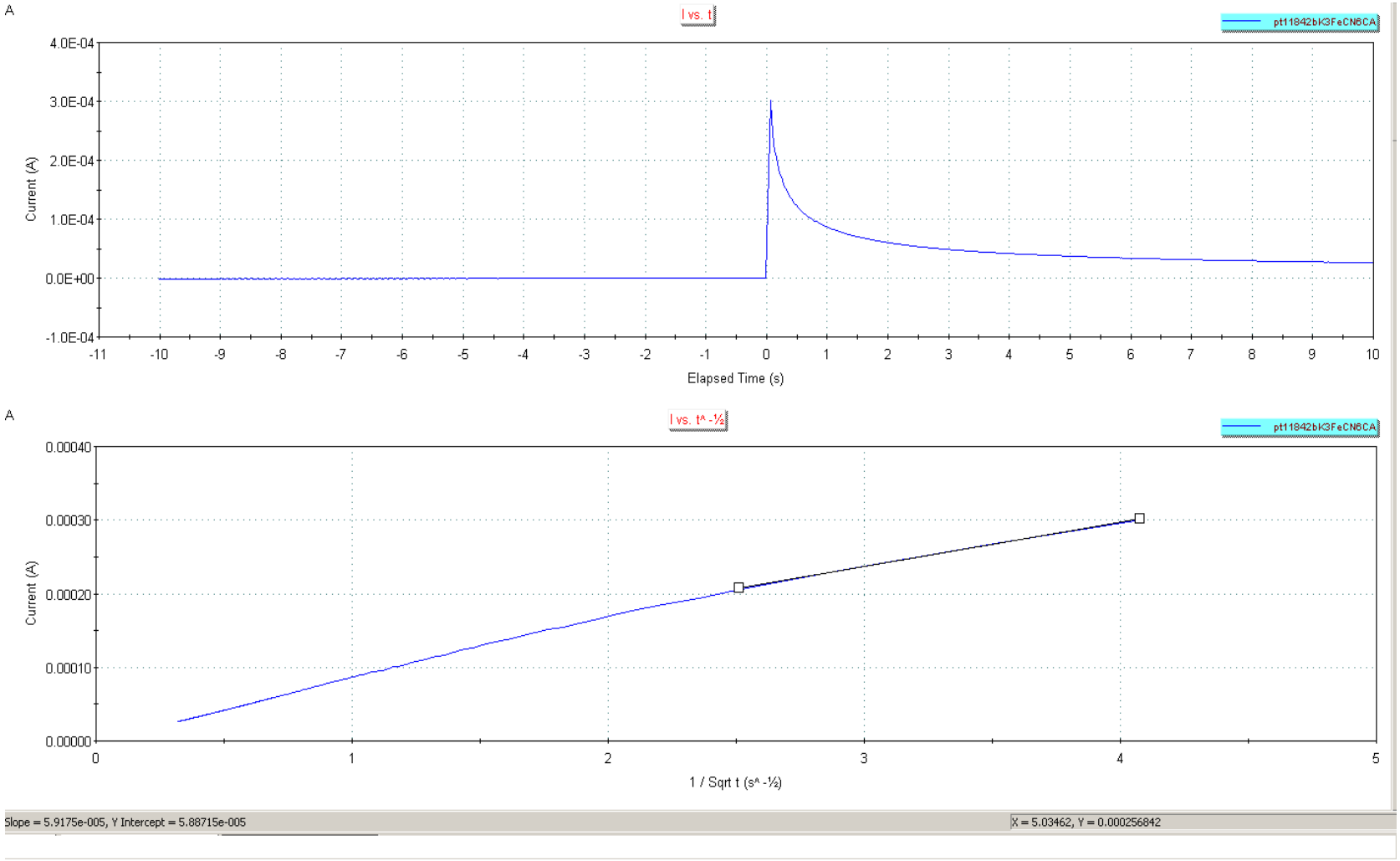
Questions And Comments ??????

Additional Slides



Cotrell Plot(Current vs. 1/t^1/2)