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Design a Cyclic Voltammetry Experiment of Lithium-ion Battery via LabVIEW

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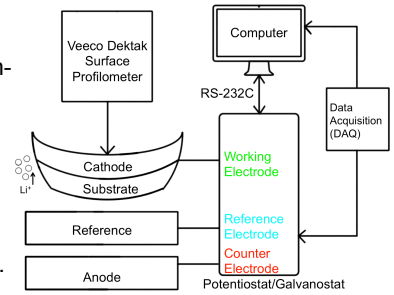
Introduction and Background

Introduction:

- Lithium-ion batteries are critical to modern and emerging technologies ranging from electric vehicles, high-power tools and wearable electronics to prosthetic limbs and exoskeletons for the physically disabled.

Objective:

- To control C-rate and associated voltages for lithium-ion batteries during (dis)charging via Labview.
- Obtain the relationships between C-rate and residual stresses inside electrode materials during (dis)charging.



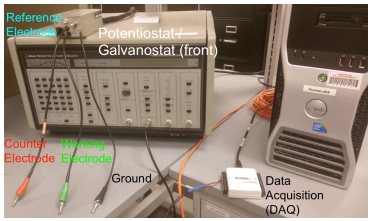
Equipments and Materials:

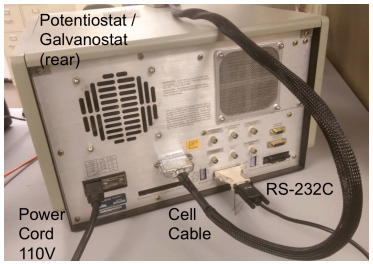
- A Potentiostat/ Galvanostat Model 273:
  - Aid in conducting electrolysis experiments.
  - Controls voltage and current applied to a battery cell.
  - Three electrodes:
    - Working – studied material.
    - Reference – set zero potential.
    - Counter – completes circuit, current flow exits .
- DAQ 6009 from National Instruments.
- Computer Interface: modified RS 232C cable (serial cable) with USB connection and a 25 to 9 pin adapter.

Methods and Results

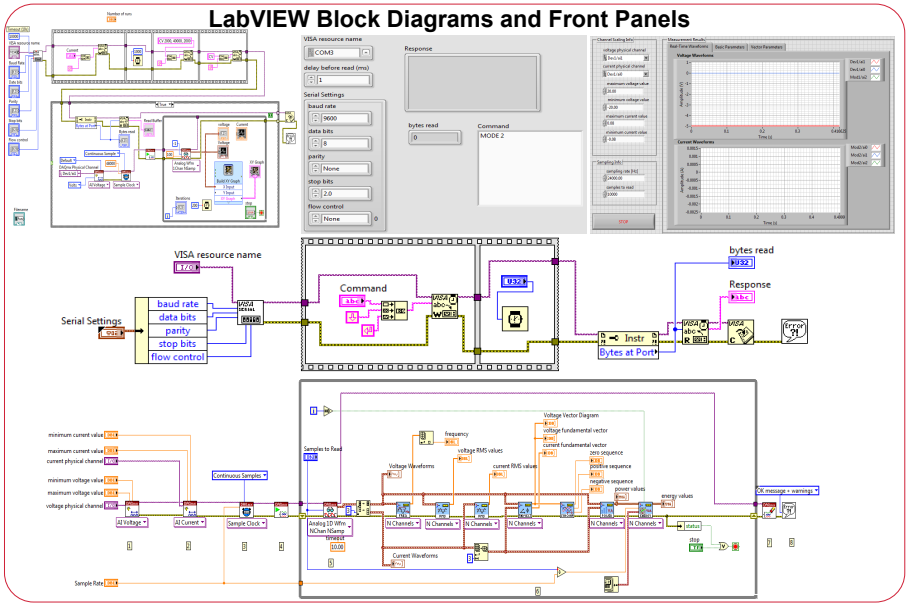
Equipment:

EG&G Princeton Applied Research 273 potentiostat / galvanostat





LabVIEW Block Diagrams and Front Panels



Detailed experimental Setup

1. Connect potentiostat/galvanostat to resistors and a customized Li-ion thin-film batteries. Three different electrodes are used to establish a better connection with the battery.
2. Establish communications between the potentiostat/galvanostat with the computer via the RS 232C cable.
3. Utilize a data acquisition device DAQ 6009 to transfer analog data to digital ones from the potentiostat/galvanostat to the computer
4. Build a LabVIEW program to control and receive feedbacks from the potentiostat/ galvanostat. Several LabVIEW blocks are presented to demonstrate our capability of better controlling the potentiostat/galvanostat.

Future Study

Connect with nanofabricated lithium-ion batteries to conduct residual stress measurements.

Discussions and Conclusion

- The completed research provides a solid interface and good structure upon which further research on lithium ion batteries will be allowed to take place
- Complete control of Potentiostat/Galvanostat from a host computer is made possible through LabVIEW programming;
- Proper usage of Potentiostat/Galvanostat Model 273 requires much research and detailed knowledge of inner workings and command list
- Improvements must be made to Labview program and hardware for more ideal results- RS 232C replaced with GPIB, higher DAQ system
- Modify program to be able to satisfy diverse control method and test approach.

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