
Spring 4-2015

Organic Solar Cell at Room Temperature

Deedra Zeeh

University of Southern Maine

Follow this and additional works at: https://digitalcommons.usm.maine.edu/thinking_matters



Part of the [Electronic Devices and Semiconductor Manufacturing Commons](#)

Recommended Citation

Zeeh, Deedra, "Organic Solar Cell at Room Temperature" (2015). *Thinking Matters Symposium Archive*. 40. https://digitalcommons.usm.maine.edu/thinking_matters/40

This Poster Session is brought to you for free and open access by the Student Scholarship at USM Digital Commons. It has been accepted for inclusion in Thinking Matters Symposium Archive by an authorized administrator of USM Digital Commons. For more information, please contact jessica.c.hovey@maine.edu.

Organic Solar Cell At Room Temperature

Deedra Zeeh University of Southern Maine EGN 403- Professor James Masi

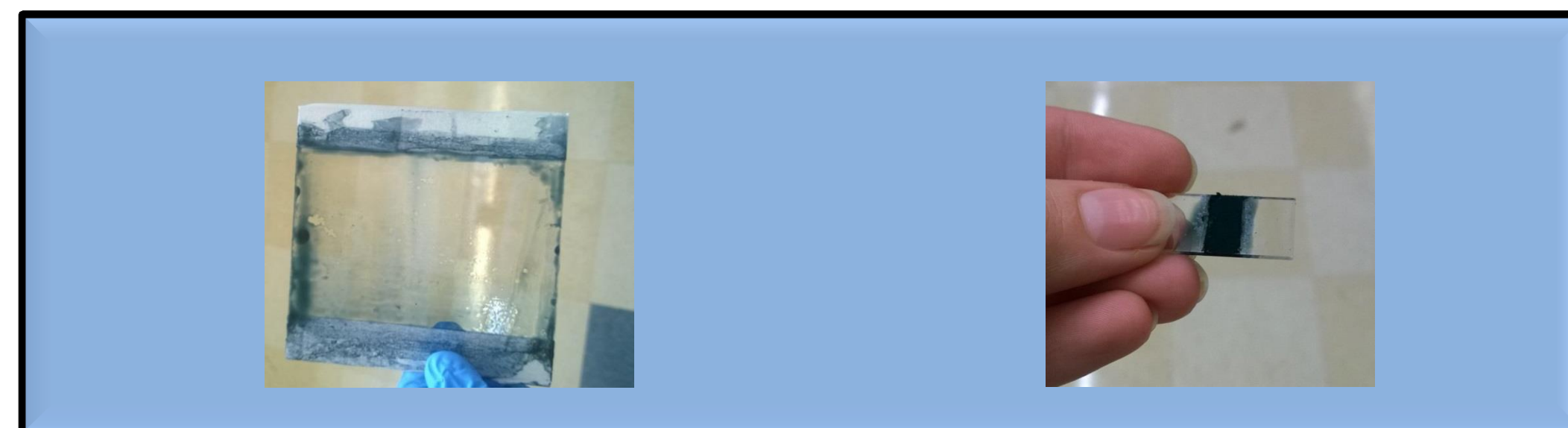


Problem Statement

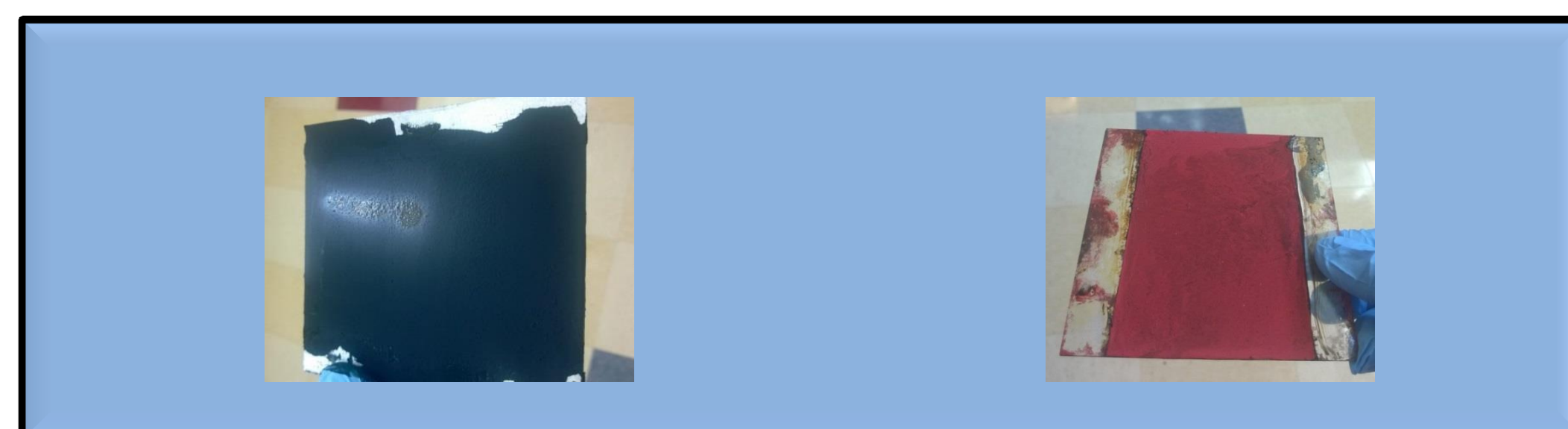
Organic electronics have become of great interest in the field of materials science research due to the potential for flexible electronic devices and low cost technologies. Difficulties emerge with creating a stable and efficient device, while still maintaining a simple and room-temperature production process.

Design Process

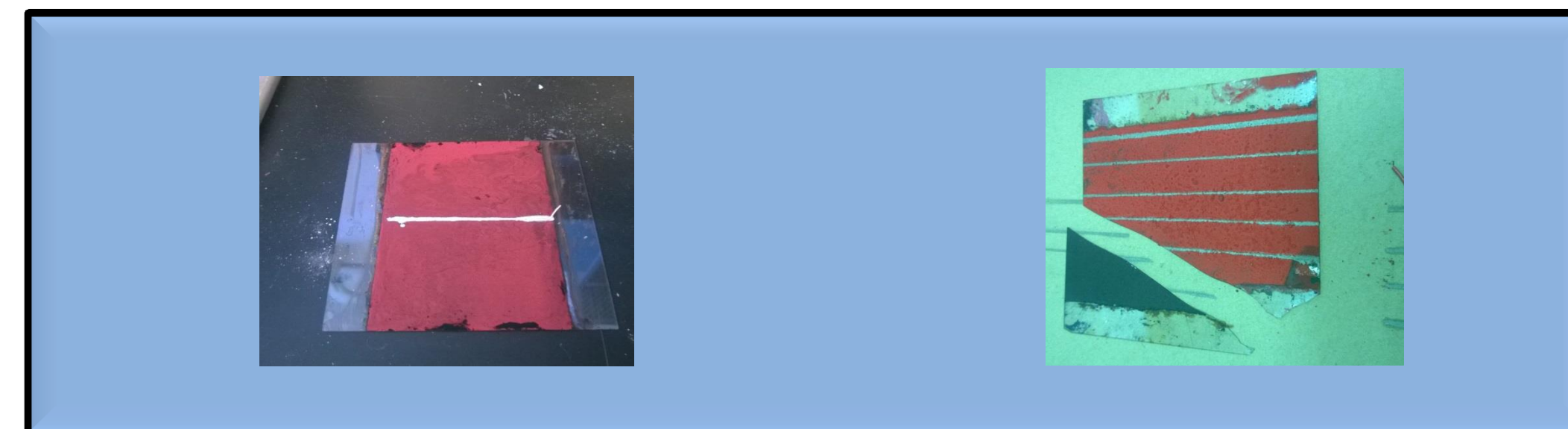
- 1) Glass ITO
- 2) PEDOT-PSS



- 3) Polyaniline
- 4) Active layer- P3HT + Perylene

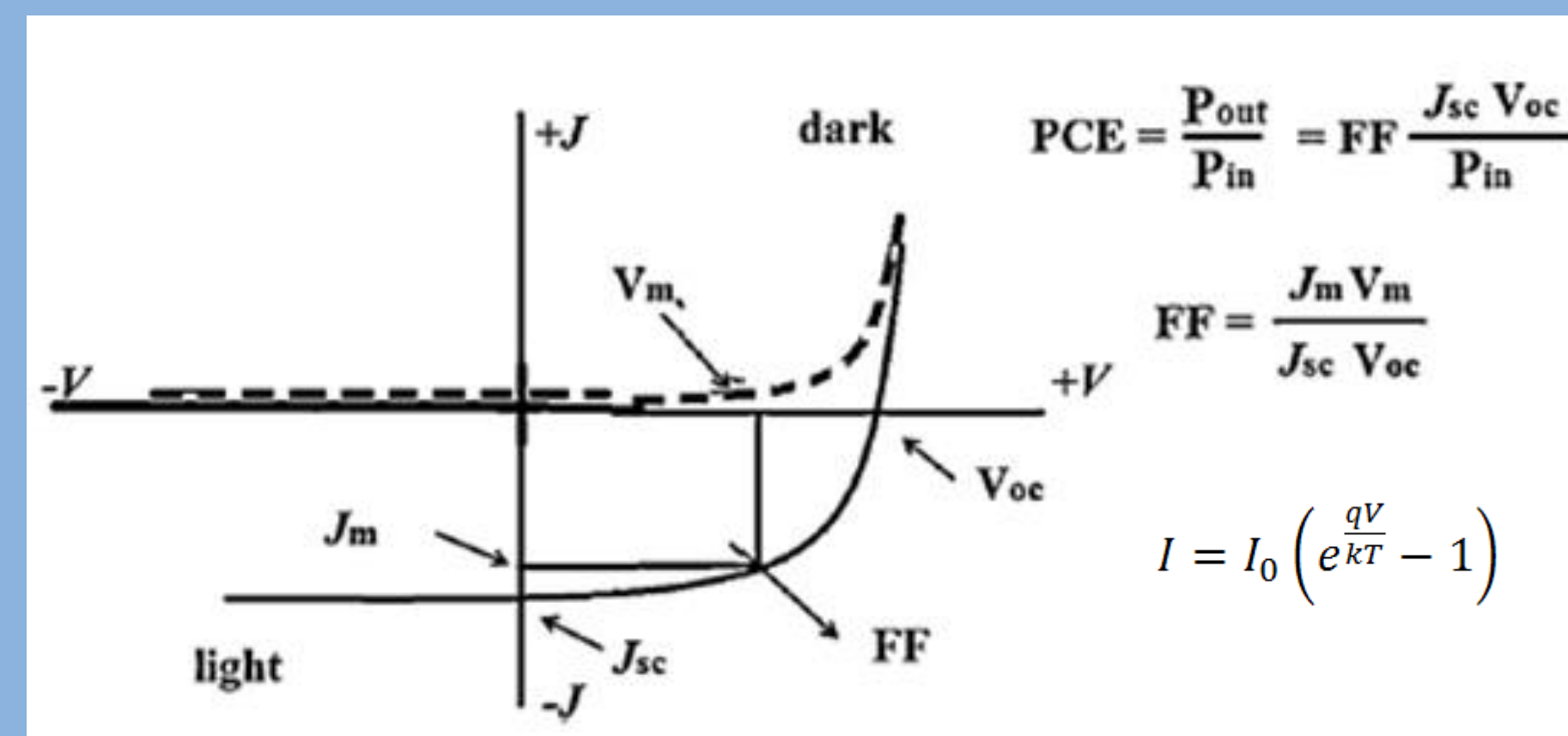


- 5) Silver Anode

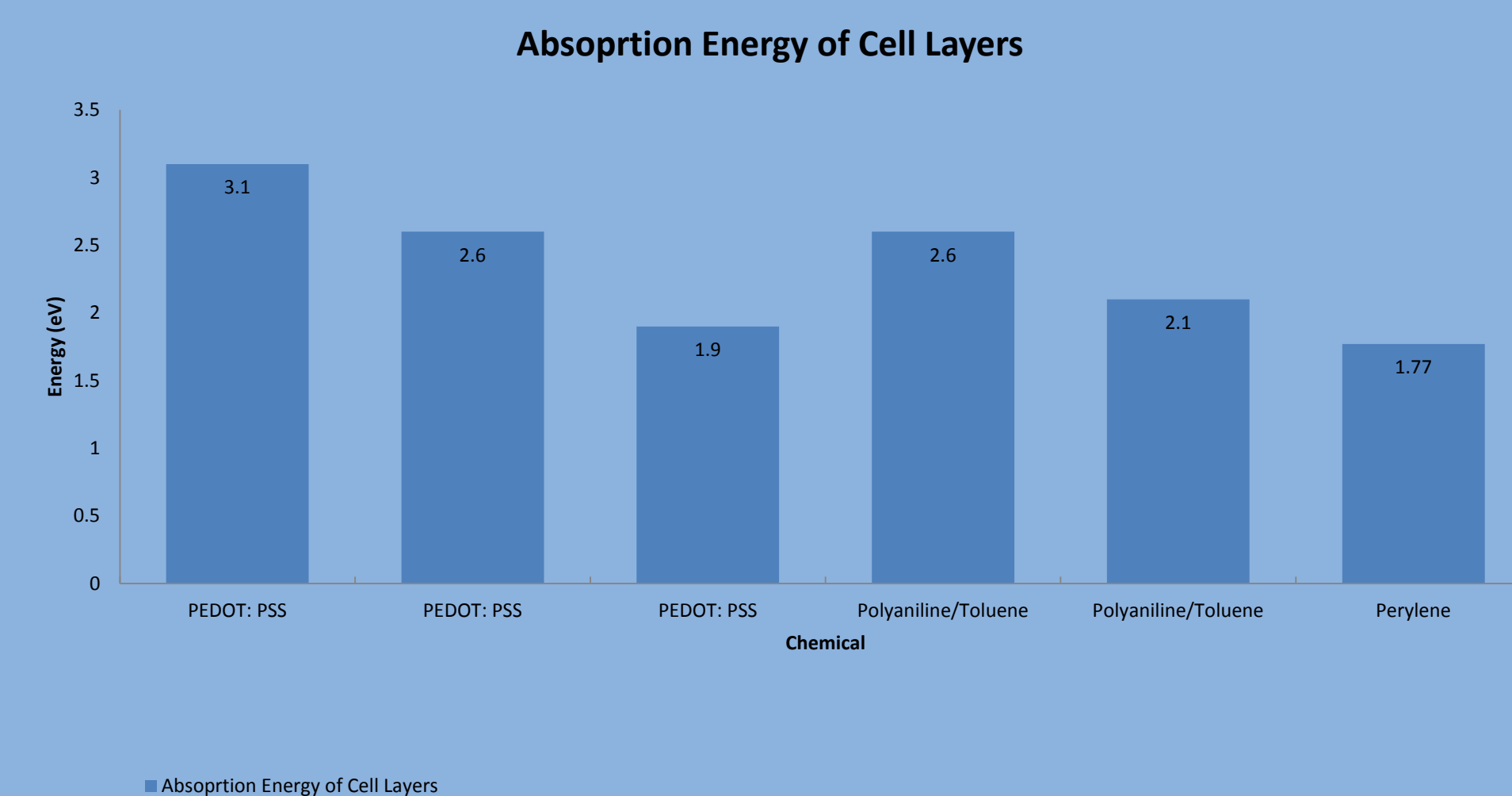


Background Research

- Layers of the Cell:
 - Glass, ITO
 - PEDOT:PSS= HTL/ buffer
 - PANIN= interfacial layer
 - P3HT-Perylene= active layer
 - Cathode
- Factors that Limit Solar Cell Efficiency:
 - Defect- recombination
 - Energy loss- heat
 - Reflection
 - Electron affinity



Abstract: With the advent of relatively stable organic semiconductors and graphene (or other nanotube or fullerene morphologies), it is possible to fabricate photovoltaic cells at near room temperature. By stacking these cells, devices of reasonable efficiencies >5% can be fabricated. Devices were created with a perylene-P3HT photoactive layer, polyaniline buffer layer, and PEDOT:PSS as the hole transport material. Devices were fabricated, tested for J-V characteristics, and re-designed for a final structure.



Results

- Focus on increasing layer stability
- Paste spread to help improve stability
- Spectral response of diode
- Barrier layer

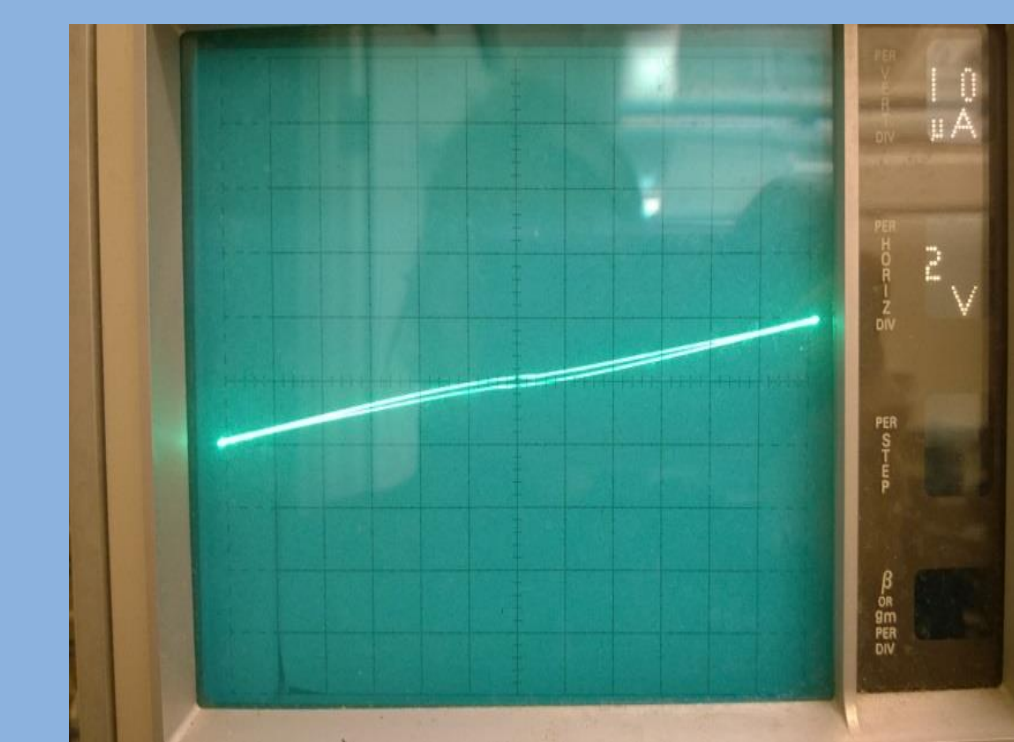


Figure 3. I-V trace results on earlier cell model

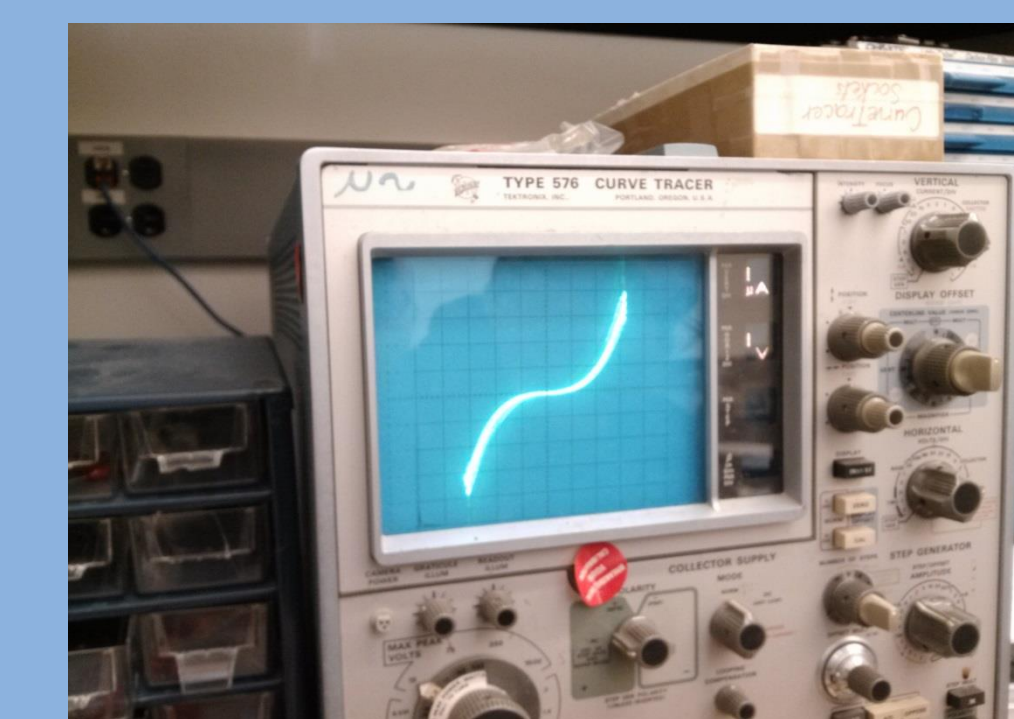


Figure 4. I-V trace results on newer cell model



Figure 5. Control test results on factors affecting cell material stability

Figure 5) Control test was done varying factors such as number of coatings, anneal time, and mixing time of the active layer

Solar Cell Standards:

- EN 50461: Solar Cells- Information on silicon solar cells
- IEC 60904(1-10): Photovoltaic Devices-I-V characteristics, computation and testing, spectral response
- ASTM E1143, E1125: Cells Testing Parameters, Calibration Using Tabular Spectrum
- IEC 61215, 61277, 61646, 61730: Design qualification, power generation, type approval, safety qualifications
- JRC ISSPRA 503, IEEE 1513, ASTM E1038: Test Procedures for silicon devices, qualification of devices, standard methods in various environments
- ASTM E1799, E1802, E2047: Visual Inspection Standards, Mechanical Integrity

References (for all references please see Deedra Zeeh)

- Stergiou, Anastasios, Georgia Pagona, and Nikos Tagmatarchis. "Donor-acceptor Graphene-based Hybrid Materials Facilitating Photo-Induced Electron-transfer Reactions." *Beilstein Journal of Nanotechnology* (2014): 1580-589. Print.
- "Shunt Resistance." *PVEducation*. Web. 9 Dec. 2014. <<http://www.pveducation.org/pvcdrom/solar-cell-operation/shunt-resistance>>.
- "Part II – Photovoltaic Cell I-V Characterization Theory and LabVIEW Analysis Code." - *National Instruments*. Web. 9 Dec. 2014. <<http://www.ni.com/white-paper/7230/en/>>.
- Kuo, Chin-Tsou, and Chun-Hua Chen. "Characterization of Polyaniline Doped with Diphenyl Phosphate." *Synthetic Metals* (1998): 163-67. Print.
- Poole, Ian. "Schottky Diode Characteristics & Specifications." *Radio Electronics.com*. Web. 8 Oct. 2014. <http://www.radio-electronics.com/info/data/semicond/schottky_diode/characteristics-specifications-parameters.php>.

Acknowledgements:

I would like to thank Chad Seeley for his help in the lab. Also thanks to Dr. Masi for all of his guidance and support throughout the project.

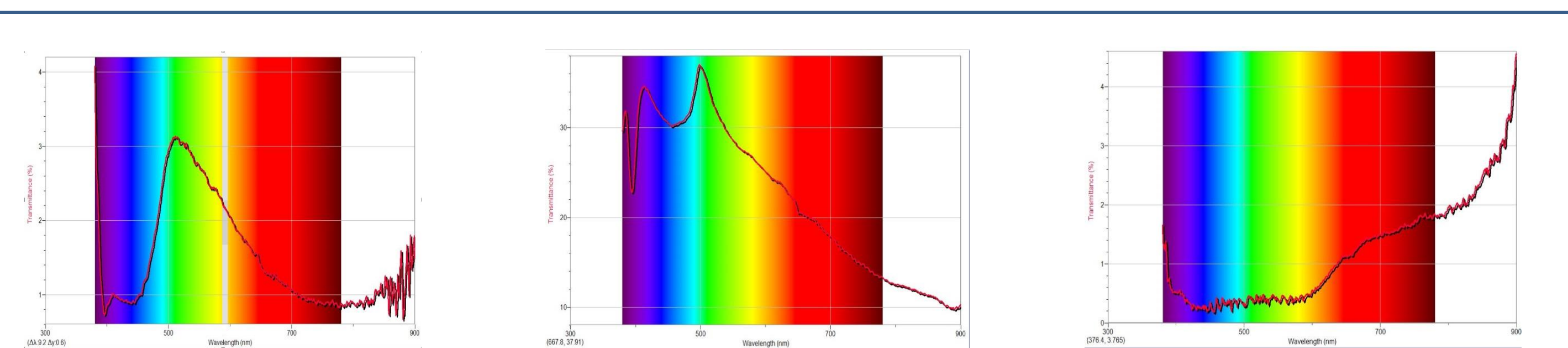


Figure 1. Spectrophotometer results of cell materials

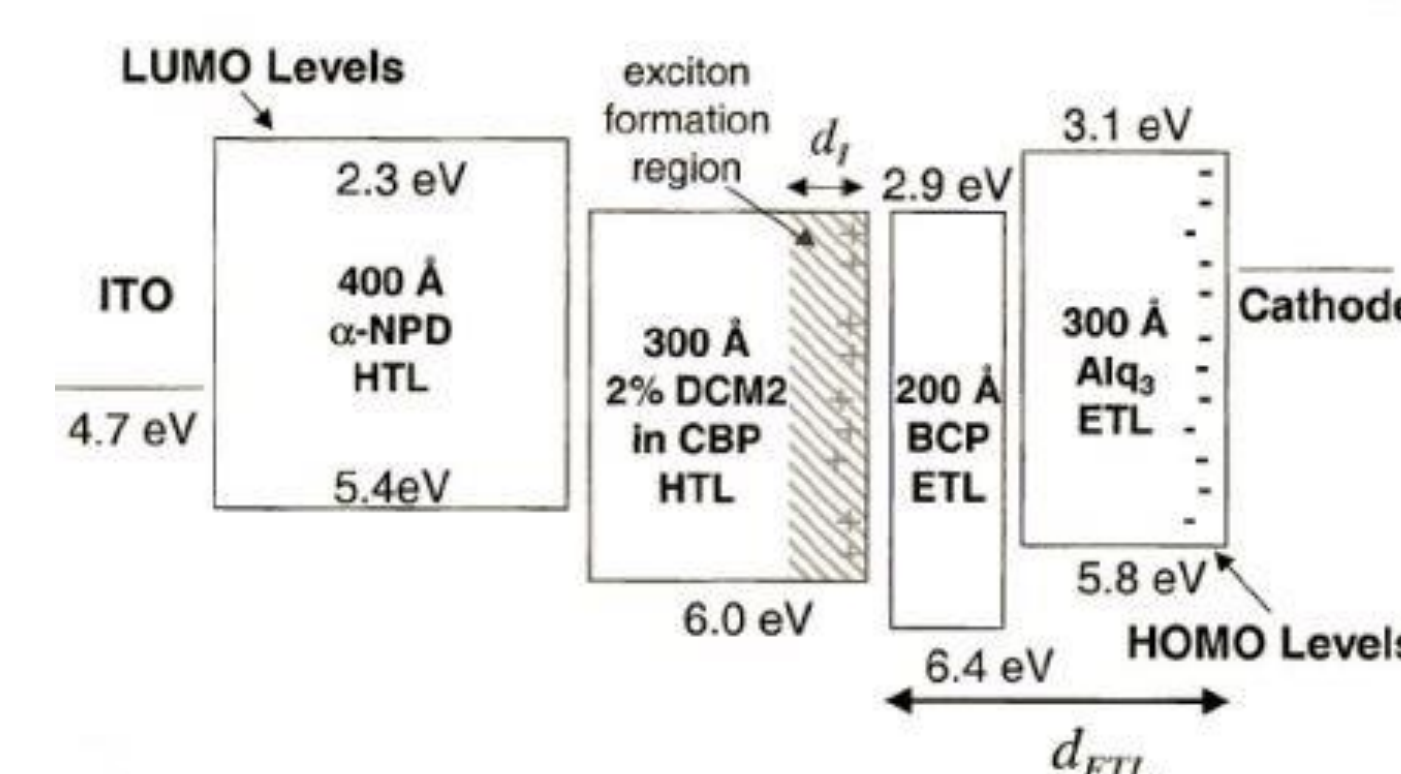


Figure 2. Sample of energy levels in a solar cell