Organic Electronic Fabrication and Investigation of Organic Magnetoresistance

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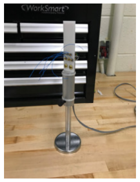
ABSTRACT

The field of organic electronics has advanced in recent years to create new devices for both display and memory-storage technology. Our research investigates organic magnetoresistance (OMAR) in organic semiconductors, specifically organic light emitting diodes (OLED). In the past we have carried out fabrication and measurement at the University of Iowa. To study OLEDs here at UW-Eau Claire requires the design and manufacturing of new equipment and for us to develop creative fabrication methods which take advantage of the facilities we have on campus. A specimen holder was designed using computer aided drafting and modeling and then fabricated using an automated mill and metal lathe. The OLEDs were designed using evaporative deposition techniques for the organic layer (Alq3), the Calcium cathode, and finally an Aluminum coating on an etched indium-tin-oxide coated glass slide. The geometry of the specimens is as such that numerous devices can be placed on a single slide. Lastly, to control our experiment and for data acquisition, a LabView program was utilized.

Device Holder Model



Device Holder and Stand

Introduction

The first phase of research consisted of experimental design, fixture manufacturing, and device fabrication. Experiments were previously conducted at the University of Iowa. The hope of the first phase of research was to move both the manufacturing and testing of organic light emitting diodes to the University of Wisconsin-Eau Claire.

Experimental design

Specimen Mount

The design of the specimen mount needed to be as such, to hold the OLED devices within the uniform magnetic field created by a field generator. It consisted; of 3 parts, a non-conductive specimen plate for the devices to be mounted, a mount holder which allowed the operator the flexibility to adjust the position and orientation of the devices, and magnetic base and stem. The designs for these components were created in Solidworks and then manufactured using a manual and automated mill and a metal lathe.

Data Acquisition and Design complications

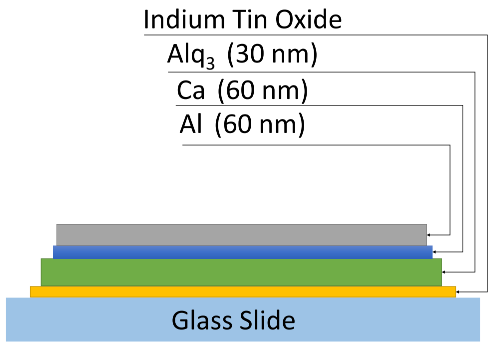
To acquire the minute resistance fluctuations in low magnetic fields, an ammeter, interfaced by a LabView program, will be used. The magnetic field strength is to be measured by a Hall Effect sensor. The magnetic field strength will be controlled by a precision voltage source generator, which will step through a specified voltage range, automated by the LabView program mentioned above.

The voltage source instrument does not currently allow for a scan from positive to negative voltages. This complicated our data due to the interesting magnetoresistance effects happens in magnetic fields with strengths near zero. To resolve this complication, with the current instruments, a cleaver circuit design will need to be designed to seamlessly sweep the magnetic field strength through zero.

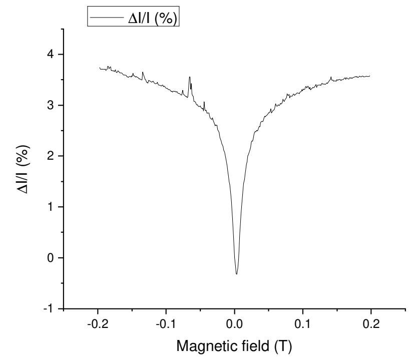
Fabrication

BASIC POSTER DESIGN GUIDELINES

- Draw anti-etchant lines on ITO slides
- Etch exposed ITO (Collector)
- Cut the slides to appropriate device size
- Clean with in a sonic cleaner
    - Soap and water
    - Water
    - Acetone
    - Isopropanol
- Deposit Alq3 using a thermal evaporator
- Deposit Calcium (Injector)
- Deposit Aluminum (Protects the Ca layer)



OLED Device Cross-section



OMAR Effect Graph from the University of Iowa Data

Second Phase

The second semester of this research project will consist of following goals.

- Continue manufacturing OLED devices on the UWEC campus
- Refine the manufacturing processes to maximize production efficiency
- Conduct magnetoresistance experiments on the UWEC campus
- Investigate OMAR effects in our OLEDs

Acknowledgments and references

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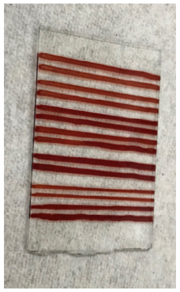
Student and Faculty Collaboration:

- Connor Feltman, Student
- Dr. James Rybicki, Faculty Advisor
- Turner Howard, Lab Specialist



ITO Line Etching

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