INVESTIGATING AND ADDRESSING PHOTODEGRADATION OF CONJUGATED POLYMERS FOR SOLAR APPLICATIONS
UREP 22 - 024 - 1 - 002
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1. Background

- P3HT is a promising organic photovoltaic polymer
- Challenges of solar energy research
  - Low energy density
  - Erratic energy availability
- High Flux Solar Simulator (HFSS)
  - Independent of weather
  - Can vary flux output

2. Goals and Objectives

1. Design & build setup for the solar aging and material characterization
2. Characterize the radiation-flux of the HFSS
3. Characterize P3HT polymer films
4. Investigate Solar cell stability

3. Methodology

Flux Characterization of HFSS:

- Grayscale Map
- Incident Flux Measurement
- Flux Distribution

Using: CCD camera
Using: Flux gauge

Optical Simulation using TracePro:

SolidWorks Ixe Lamp Model
Simulated flux map

Development of Neural Network:

Sample Preparation:

AFM images
Drop-cast samples
Spin coated samples

Aging Experiment:

Before aging
After aging

4. Results

Accuracy of neural network predictions

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>x</th>
<th>y</th>
<th>z</th>
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<td>% of prediction errors within 1 mm</td>
<td>89%</td>
<td>87%</td>
<td>30%</td>
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Aging experiments and Characterization

- Change in absorbance vs. Flux dosage
- Absorbance at different time intervals (P3HT exposed to 1kW/m² (1 sun) at 25°C)
- Absorbance at different time intervals (P3HT exposed to 3.7 kW/m² at 25°C)

5. Significance

Project Outcomes:
1. Retrofitted the HFSS for experiments
2. Proved effectiveness of neural networks in the optimization of HFSS lamp arrangement
3. Developed an equation that quantifies the degradation rate of P3HT

Academic Outcomes:
1. Published a thesis on optimization of HFSS using machine learning
2. Presented at 7 conferences in USA, France, Malaysia and Qatar
3. Applied a wide variety of engineering software:

6. Recommendations

1. Develop the neural network for complete seven lamp set-up
2. Utilize HFSS for testing photodegradation of materials and photocatalytic reactions
3. Identify a method to stabilize P3HT (such as doping or mixing with other organic photovoltaic materials)
4. Replace P3HT it with a more stable polymer such as P3HS

Acknowledgement: This publication was made possible by the UREP award [UREP-22-004-1-001] from QNRF (a member of The Qatar Foundation). The statements made herein are solely the responsibility of the authors.

High degradation of P3HT observed described by:
% Degradation (P3HT) = 98 – 0.29 * dosage