Continuous Electrically Assisted 3D Printing of Large Scale PEDOT:PSS Film for Solar Cell Fabrication

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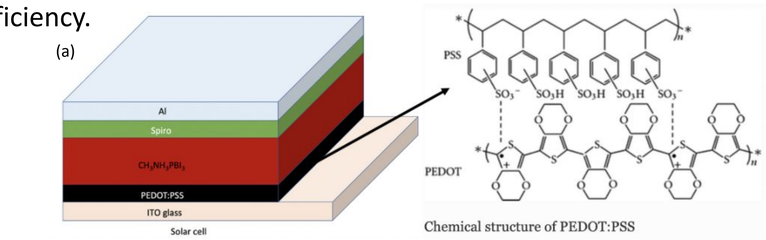
1. Introduction

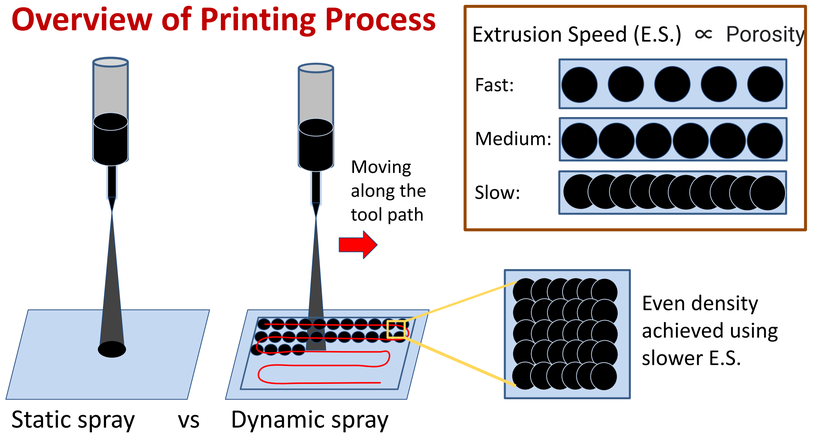
The PEDOT:PSS solar cell offers an environmentally friendly energy source alternative compared to the traditional lithium-based batteries. They are an ideal source for powering electronic devices for their superior conductive material properties. Additive manufacturing enhances the energy storage capabilities of solar cells. 3D printed solar cells will offer a low cost, high energy-efficient solution to this problem. It is necessary to understand how to fabricate the PEDOT:PSS film by using 3D printing to improve the conductivity and energy efficiency.



2. Abstract

This research project aims to control the density and morphology of the 3D printed nanofilm for optimum energy conversion efficiency. To fabricate individual solar cell layers, an additive manufacturing (AM) process is used in conjunction with an electric field. Challenges include accurately controlling the parameters to produce an even density coating. In this project, printing parameters such as voltage, distance, and extrusion speed will be adjusted to develop the ideal micro/nanostructure. Post process techniques will include annealing procedures to further refine the substrate. Upon successful completion of this project, the research could lead to a shift in the solar cell manufacturing approach.

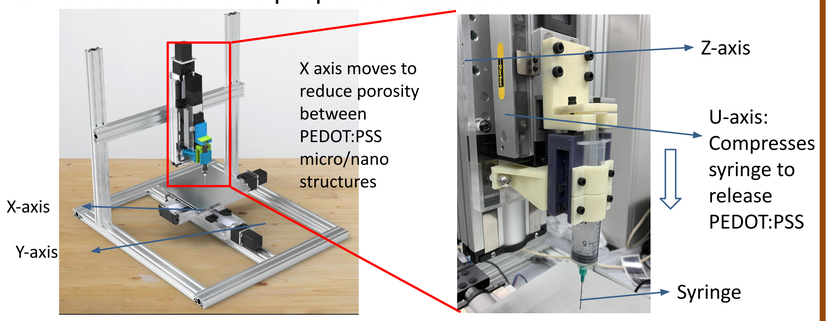
Overview of Printing Process



3. Construction of EF-NIW

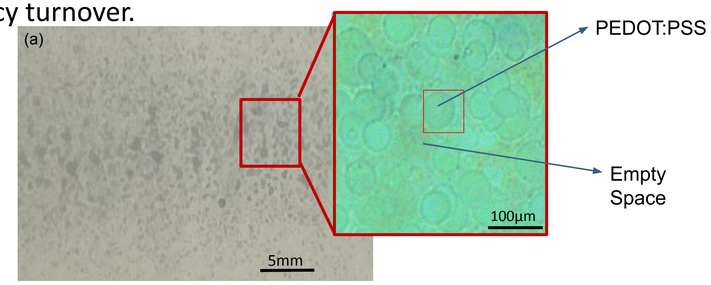
Overview of Electrically Assisted 3D Printing

Fabricate high density PEDOT:PSS film by using an electrical field-assisted 3D printing approach. An electric field-assisted nano ink writing (EF-NIW) based additive manufacturing (AM) process will be established for the fabrication of the PEDOT:PSS nanomaterial with controlled density and micro/nanostructures. Density and the morphology of 3D printed micro/nanostructures will be studied in this proposed research.



Large Scale Printing of PEDOT:PSS

Based on the current 3D printed setup, the extrusion speed depends on the amount of material being ejected from the syringe, the distance the x-axis will travel, and the speed at which it travels. Moving the axis enables an even coating to be distributed over the entire sample rather than having a more concentrated center which results from static movement. The image below shows the porosity from static movement. By moving the x-axis, the plume will cover the empty space, producing a thick, even density coating with high energy efficiency turnover.



4. Future work

1. Measure the density and conductivity of the PEDOT:PSS 3D printed nanofilm based on parameters
2. Adjust printing parameters for perovskite material
3. Relate deposition diameter to extrusion speed
4. Optimize micro/nanostructure characteristics

Acknowledgments

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Reference:[1]Ahn, Namyoung et al. "Trapped Charge-Driven Degradation of Perovskite Solar Cells." Nature communications 7.1 (2016): 13422–. Web.
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