Aerospace Engineering Thesis Defense

Electrical Conductivity and Wettability Evaluation of Thin PEDOT: PSS films Printed via Electrically Assisted Direct Ink Deposition with Ultrasonic Vibration for Perovskite Solar Cells

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Abstract

Direct Ink Deposition is a type of 3D printing that utilizes a nozzle to coat thin films onto substrates. Electrospray deposition is a subcategory of DID wherein a very strong electric field is applied between the nozzle exit and the substrate, which results in the precursor polymer ink to be sprayed onto the substrate in the form of micro- or nano-droplets. The objective of this research is to see how application of ultrasonic vibrations during, and post deposition affects the morphology, electrical conductivity and surface properties of the thin PEDOT:PSS film printed via electrospray deposition. The printing setup was previously designed and constructed, wherein the syringe was loaded with the PEDOT:PSS and IPA solution which was then printed onto thin and small sized ITO substrates under the application of a high voltage. The distance of the nozzle from the substrate was appropriately adjusted via the vertical linear movable stage before printing, as well as the voltage supply. Deposition time was set using an Arduino code that controlled the horizontal movement of the shutter attached to the bottom of the vertical linear aluminum frame. Horizontally and vertically induced vibrations were turned on during and post deposition to analyze the effect of both on the films' properties through an ultrasonic transducer. The electrical sheet resistance of the PEDOT:PSS films was measured using a 4-point probe device and the surface contact angle of water on the PEDOT:PSS was measured using a contact angle meter. From the results obtained, it was concluded that the application ultrasonic vibrations improved wettability compared to the films printed without any vibrations. Furthermore, the electrical sheet resistance and contact angle of pure ITO was measured as a reference.

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