Development of a Hybrid Direct Write 3D Printer: A Novel One-Step Approach to Fabricating Multi-Layer Functional Devices and Flexible Electronics Through Reactive Inkjet Printing

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Novel methods and devices, which can print conductive inks and 3D architectures, are desperately needed. A multi-material 3D printer capable of printing electronics would revolutionize modern technology in an astounding number of fields. This project explores the utilization of a multi-faceted inkjet technology and Fused Deposition Modeling (FDM) 3D printing in the fabrication of flexible electronics. The goal of the project is to print revolutionary multi-layer circuits, next-generation perovskite solar cells, batteries, and medical sensors using a novel hybrid 3D printer. The only existing technology available to print metals is Electron Beam Melting and Selective Laser Sintering methods. Metal 3D printing is made more commercially available and accessible to a variety of different fields as a platform to test devices. These techniques of metal printing are limited to industrial machines and require a large amount of energy to sinter the metals. In order to reduce overall energy usage and post-print processing time, a low-cost photonic sintering lamp was used. The most popular single extruder machines are limited to one material per print. The developed multi-material 3D printer has the capability to incorporate high-resolution conductive traces in a variety of dual-polymer prints. With the capability of depositing six materials simultaneously, the system can reactive inkjet print high-quality perovskite solar cells. The system handles multiple tool heads through a unique data handling process allowing for a streamlined and efficient process to deposit and sinter materials. The multi-faceted desktop system will allow for the streamlining of multi-layer flexible electronics fabrication.

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