

DIRECT INK WRITING OF FUNCTIONAL PASTES AND INKS FOR SMART TEXTILES

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ABSTRACT

Additive manufacturing technologies, better known as three dimensional (3D) printing technologies, have been of increasing importance to the industry, research institutions and the private area. Simple structure generation with computer-aided design (CAD) and the broad diversity of materials available allows creating precisely tailored shapes for every application, making it a perfect technique for rapid prototyping. Furthermore, printing of functional pastes and inks with direct ink writing (DIW) as a fabrication method, allows realizing flexible structures on textiles for smart applications, e.g., conductive inks for circuit paths or heating structures, efficient printing of chromatic materials, manufacturing of sensors or precise placement of electrolyte materials for flexible energy systems. The manufacturing of smart textiles with the use of such innovative technologies as 3D printing allows creating prototypes with individual functions and designs in less time.

In this paper, we present a customized 3D printing device, capable of DIW on textiles, using a pneumatic controlled syringe-based extruding system. Ink and paste deposition is controlled carefully through printing- and pneumatic parameters, as well as fluid viscosity. We describe the process of pattern generation with CAD and translation to a layer-based data format. Several functional printing pastes and inks will be used to create smart textile systems with different functions e.g., heating, colour change, lighting and energy storage. The challenge is to provide a clean and reproducible printing result for smart textiles, withstanding multiple wearing and bending cycles, to provide a long-lasting function in daily life. To achieve a durable and washable textile, encapsulation of the printed surface is necessary. Implementing DIW into the manufacturing process of smart textiles has the advantage of easy scalable and precise printing results for flexible applications, time efficiency due to rapid CAD development, less waste due to precise material placement and therefore cost-efficient use of expensive material.