Mechanical Engineering

VCU Innovation Gateway
Office of Research and Innovation

Electro-Hydrodynamic Printing

A dual jetting apparatus design for 2D/3D Electro-Hydrodynamic printing

As an emerging printing technology, Electro-Hydrodynamic (EDH) printing has demonstrated the ability to fabricate micro-/nano-scaled patterns because of its high resolution, good compatibility with ink variety and substrates, and all of the attributes of conventional inkjet printing. EHD printing has been successfully applied for direct 2D and 3D fabrication of micro-/nano-scaled structures. However, different from conventional inkjet printing, ink droplets in the EHD printer are pulled out rather than being pushed out from the nozzle by an electric field.

As nozzle size decreases for increased resolution and functionality, nozzle clogging is inevitable. Mechanisms of clogging include: colloidal suspensions, agglomeration of primary particles, shear-induced gelation in liquid and solvent evaporation, and/or ink polymerization during the printing. To prevent this, EHD printing uses extremely diluted ink that affects quality of print features and throughput. A need therefore exists for a new printing nozzle design that enables the use of non-diluted ink and a circulating ink path, to prevent the nozzle from clogging.

The technology

Inventors at Virginia Commonwealth University have developed a dual-channel jetting apparatus for 2D/3D EDH printing on substrates. This new dual channel jetting design alleviates clogging issues commonly faced by EHD printers. During printing, ink is continuously injected into the nozzle through one flow channel and extracted from the other. A stable ink meniscus is established at the opening of the nozzle, where the ink bridges the two channels. When an electric field is applied between the nozzle and the substrate, the ink meniscus is activated and one single droplet is pulled out. The unconsumed ink is constantly recirculated to prevent solvent evaporation/ink polymerization. The unique nozzle design has jetting characteristics and meniscus dynamics different from those in conventional EHD printing. Two alternative nozzle configurations are also presented.

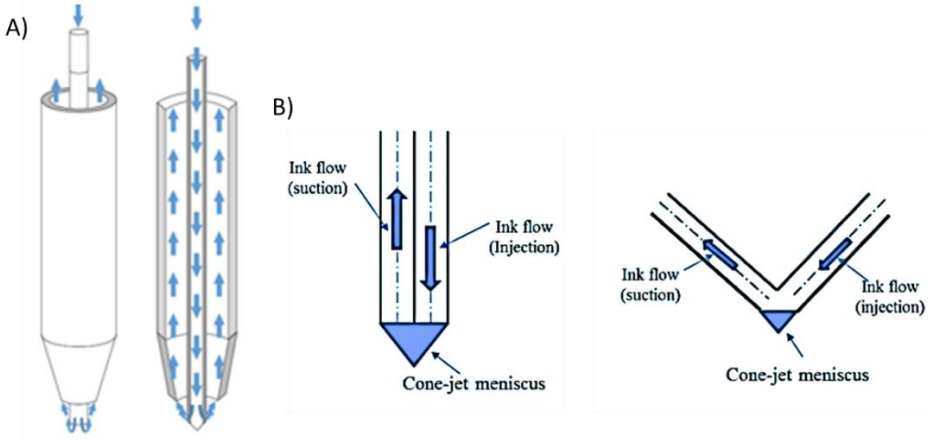

Figure 1. ***A)*** *Schematic diagrams of the dual-channel nozzle with the circulating ink path;* ***B)*** *Alternative nozzle designs*

Benefits

- Reduced colloidal particle agglomeration and flow channel clogging
- Robust jetting performance
- Improved ink flow & flow rates
- Minimized ink waste

Applications

- High resolution patterning of functional devices
- Fabrication of electronic devices
- Additive manufacturing
- Fabrication of optical devices
- Hybrid additive micro-/nano-printing
- Micro-electronic manufacturing
- Pharmaceutics biomolecular patterning

Patent status:
Patent pending: U.S. and foreign rights are available.

License status:
This technology is available for licensing to industry for further development and commercialization.

Category:
Mechanical engineering

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