

High Resolution Electrohydrodynamic Jet Printing for Flexible Electronics

John A. Rogers, University of Illinois (USA)

Abstract

Efforts to adapt and extend graphic arts printing techniques for demanding device applications in electronics, biotechnology and microelectromechanical systems have grown rapidly in recent years. This paper describes the use of electrohydrodynamically induced fluid flows through fine microcapillary nozzles for jet printing of patterns and functional devices with sub-micron resolution. Key aspects of the physics of this approach, which has some features in common with related but comparatively low resolution techniques for graphic arts, are revealed through heuristic models and direct high speed imaging of the droplet formation processes. Printing of complex patterns of inks, ranging from insulating and conducting polymers, to solution suspensions of silicon nanoparticles and rods, to single walled carbon nanotubes, using integrated, computer controlled printer systems illustrates some of the capabilities. High resolution, printed metal interconnects, electrodes and probing pads for functional transistors and representative circuits with critical dimensions as small as 1 micron demonstrate potential applications in printed electronics.

Author Biography

John A. Rogers, obtained BA and BS degrees in chemistry and in physics from the University of Texas, Austin, in 1989. From MIT, he received SM degrees in physics and in chemistry in 1992 and the PhD degree in physical chemistry in 1995. From 1995 to 1997, Rogers was a Junior Fellow in the Harvard University Society of Fellows. During this time he also served as a Director for Active Impulse Systems, a company based on his PhD research that he co-founded in 1995 and which was acquired by a large company in 1998. He joined Bell Laboratories as a Member of Technical Staff in the Condensed Matter Physics Research Department in 1997, and served as Director of this department from 2000-2002. He is currently Founder Professor of Engineering at University of Illinois at Urbana/Champaign, with appointments in the Departments of Materials Science and Engineering, Electrical and Computer Engineering, Mechanical Science and Engineering and Chemistry.