Accepted Manuscript

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Herman Wijshoff

PII: S1359-0294(17)30152-8
DOI: https://doi.org/10.1016/j.cocis.2017.11.004
Reference: COCIS 1157

To appear in:

Received date: 1 November 2017
Revised date: 24 November 2017
Accepted date: 30 November 2017

Please cite this article as: Herman Wijshoff , Drop dynamics in the inkjet printing process. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Cocis(2017), https://doi.org/10.1016/j.cocis.2017.11.004

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Herman Wijshoff, Océ Technologies B.V. and Eindhoven University of Technology
herman.wijshoff@oce.com
Van der Grintenstraat 1, P.O. Box 101, 5900MA Venlo, the Netherlands

Keywords

Inkjet, Drop formation, Wetting, Drop impact, Drop spreading, Drop coalescence, Absorption, Evaporation.

Abstract

The inkjet printing process involves a chain of processes in many physical domains at different length and time scales. The final goal is the deposition of droplets of all kinds of fluids with any desired volume and velocity. To comply with the increasing and diverging requirements for today's inkjet technology, a fundamental understanding of the underlying processes is very important. By combining state of the art experimental and numerical techniques, the physics behind the chain of processes are being explored. The fundamental knowledge gained is crucial for the further development of the inkjet printing technology which became mature in graphical printing applications and plays a key role in many emerging new industrial and medical applications.

1. Introduction

Inkjet printing is a technique that generates droplets of fluid, the ink, which are deposited onto a substrate in a certain pattern. When the fluid contains colorants, an image is created. The inkjet printing technology has evolved into a technology which plays an important role in the graphical printing industry and in many emerging new industrial and medical applications [1, 2, 3]. Together with the development of the applications, the science of inkjet printing is also developed, which is about the manipulation of small amounts of fluid [4].

The piezo inkjet technology has unique abilities to deposit a wide variety of materials on various substrates in well-defined patterns. To comply with the increasing and diverging requirements for today's inkjet technology, a fundamental understanding of the underlying processes is very important. The physics behind the chain of processes in the inkjet printhead operation comprise the two-way coupling from the electrical to the mechanical domain through the piezo electric actuator, the coupling to the acoustic domain inside the ink channels to transfer the deformation into pressure waves, and the coupling to the fluid dynamic domain in the nozzle to transform acoustic energy into the kinetic and surface energy of the drop formation process [5].

2. Printheads and drop formation

The drops coming out of the nozzle are measured with all kind of optical techniques [6]. The drop formation with pl sized droplets at high repetition rates (up to 100 kHz) are measured with ultra high speed cameras (up to 25 Mfps) or with a laser induced fluorescent stroboscopic recording iLIF (6 ns short illumination) [7], figure 1. Numerical simulations with volume of fluid method [8], lubrication theory [9] and lattice Boltzmann [10] show a very good correlation with the experiments and provide more detailed information about the distribution of mass and velocity, breakup mechanisms.