Characterization of Droplet Ejection Process for a Piezoelectric Inkjet Printhead

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ABSTRACT

The present study aims to explore the fluid physics of the microejecting process for a full-size piezoelectric inkjet printhead by numerical simulations. In the analysis, the theoretical formulation includes a set of three-dimensional transient conservation equations of mass and momentum, with the incorporation of continuous surface force model for treating the interfacial surface tension effect. The resultant governing equations are solved using an iterative SIMPLEC (Semi-Implicit Method for Pressure-Linked Equations Consistent) algorithm for determining the flow properties. Additionally, the VOF (Volume of Fluid) method in conjunction with the PLIC (Piecewise Linear Interface Construction) computation procedure is applied to characterize the behavior of liquid surface movement. The predictions are in reasonable agreement the experiment showing the validity of the present theoretical model. With the design configuration of a commercial piezo-diaphragm printhead as an example, the time evolution of the gas-liquid interface is calculated for a complete ejection cycle period. The flow and transport phenomena in various stages, including infusion, ejection, and droplet formation, are thoroughly examined in this work. In addition, the present study shows the effects of the diameter of nozzle, the operating voltage of electrical pulse shape and the ink properties on the evolution process of the droplet, the break-off time of droplet from the ink nozzle exit, and the separation time of the main droplet and satellite droplet from the long tail droplet.

Keywords : Piezoelectric Inkjet Printhead, Inkjet Printing Process, Droplet Behavior, Numerical Simulation

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