Finite Element Based Optimization of Piezoelectric Printhead Structure Study

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Piezoelectric inkjet printing is widely used in a variety of fields as a non-contact, high-efficiency, and high-flexibility digital film preparation process. The issue of high precision piezoelectric printhead s are difficult and expensive to fabricate. In this paper, a piezoelectric printhead driving model was established based on the finite element analysis. The combined effects of the driving waveform amplitude, the piezoelectric material (PZT) and the thickness of the quartz capillary channel on the radial displacement of the piezoelectric printhead were analyzed. And the primary and secondary order of the three factors on the radial displacement were determined by the orthogonal experiment analysis. The results of numerical simulation and orthogonal experimental demonstrated that the internal radial displacement of the piezoelectric printhead reached a maximum value of 0.15 μm when the thickness of PZT was 0.1 mm, the thickness of quartz tube was 0.1 mm and the driving waveform amplitude reached 120 V. The ink droplets formed at the piezoelectric printhead were ejected more smoothly and fall more steadily. In addition, the m athematical model for internal structure of the piezoelectri c printhead was built. On the basis of it, the empirical formula of the ink drop l e t volume and the radial displacement of the printhead was obtained. Here, the theoretical basis was pproposed for the core manufacturing process of the piezoelectric printhead through the establishment and analysis of the simulation model, which reduces its manufacturing difficulty and cost and is of great significance for the vigorous development of high-precision piezoelectric inkjet printing technology.

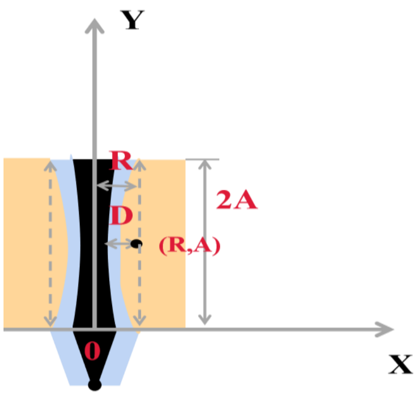

Fig. 1. Printhead structure mathematical model

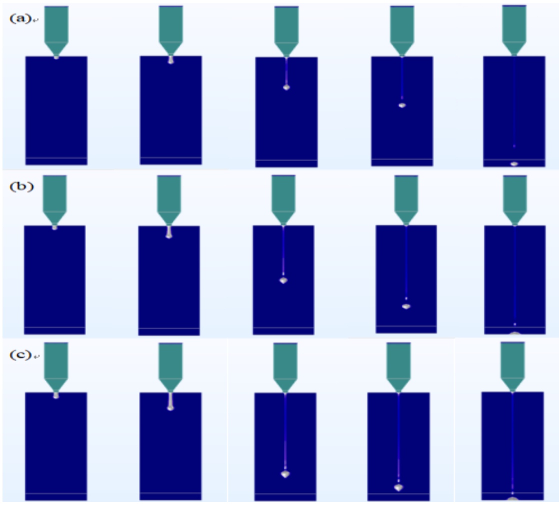

Fig. 2. Ink droplets states with different radial displacements

$$\rho\frac{\partial^2 x}{\partial t^2}-\nabla\cdot\sigma=F_v \quad (1)$$

$$x=\varphi(y)=R-\frac{D\sqrt{2Ay-y^2}}{A} \quad (2)$$

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