Proceedings of 20th International Congress on Acoustics, ICA 2010

23-27 August 2010, Sydney, Australia

Acoustic sizing of air bubbles inside a MEMS piezo inkjet printhead

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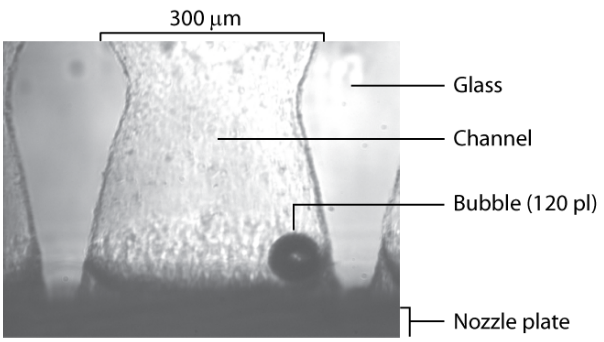
PACS: 43.25.Yw, 43.38.Fx, 43.60.Bf, 43.35.Yb, 43.20.Mv

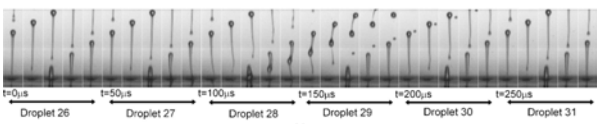
ABSTRACT

Piezo drop-on-demand (DOD) inkjet printers are used in an increasing number of applications for their reliable deposition of droplets onto a substrate. Droplets of a few picoliters are ejected from an ink jet nozzle at a frequency of up to 50 kHz. However, entrapment of an air microbubble (figure 1) into the ink channel can severely impede the productivity and reliability of the printing system [1]. The air bubble disturbs the channel acoustics resulting in disrupted drop formation (figure 2) and failure of the ink channel [2]. Here we study a new Micro-Electro-Mechanical Systems (MEMS) based print head. By using the actuating piezo transducer also in receive mode the acoustics inside the channel was monitored, clearly identifying the presence of an air microbubble inside the channel during a channel failure. A model was developed to calculate the two-way coupling between the channel acoustics and the disturbing bubble [3,4]. The model was validated by simultaneous acoustical and infrared detection of the bubble. The infrared visualization technique allowed for an accurate depiction of the bubble size and its translational dynamics inside the intact print head. The model proves to be a very valuable tool in calculating the presence, the size and the position of entrapped air bubbles inside an operating ink channel, purely from the acoustic response.



Source: (Jeurissen et al., 2009)

Figure 1. A microscope image showing an entrapped air bubble in the glass connection channel. While actuating, the fully grown air bubble will just remain oscillating in the channel indefinitely. On the left and right sides of the channel, the neighboring channels can also be seen.



Source: (de Jong et al., 2006)

Figure 2. Droplet formation recorded at 100 kfps showing the disturbance that can result in air entrapment. Droplet 26 shows regular droplet formation. Droplet 27 displays a slight deviation in the tail. Droplet 28 shows a large disturbance being jetted out. Droplets 29 and 30 display regular droplet formation again.

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