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Electric-controlled Precise and Flexible Sample Delivery on DMF

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On traditional DMF platform, droplets were normally merged with similar amount of size to realize sample delivery and mixing [1, 2]. It required the complex merging and splitting operations for multi-step reactions due to the change in concentration. The totally different protocol has intimidated biochemical researchers with the traditional training of micropipette to microfluidics.
In this work, we report a fundamentally different method called on-chip pico-pipette for sample delivery on DMF chip, which uses a phenomenon designated by "jetting". When a high AC voltage was supplied to the bar-shaped jetting electrode, groups of tiny droplets was ejected from the mother droplet to be picked up by another droplet to realize sample delivery. We tested the effect of bar width, actuation time, voltage and frequency on the jetting volume to allow a controllable volume transfer. Specific DNA identification was tested on chip. When a DNA probes specific to S. aureus was delivered to two different pathogens' DNA targets causing sepsis, S. aureus and K. pneumonia, the mismatched droplets emitted no fluorescence, and the droplet with matched combination was lit up. The experimental value of delivery volume was the same as programmed demonstrating the realiability of the pico-pipette on DMF.
This simple, low-cost and controllable delivery technique reveals a significant potential to improve the efficiency of sample transfer on DMF chips. We expect that this technology, analogous to the traditional micro-pipette can be easily accepted by biochemists and thus become a bridge to realize "lab-on-a-chip".

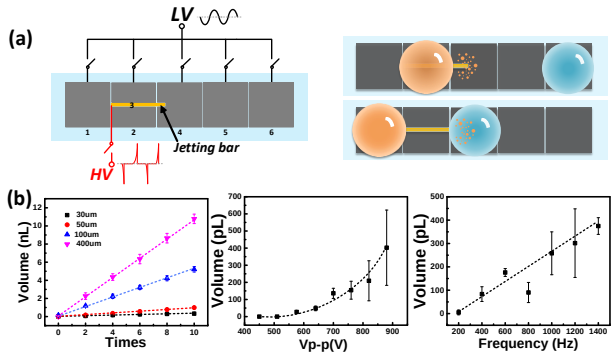

Figure 1. (a) Design of on-chip pico-pipette. (b) The effect of bar width, time, voltage and frequency on

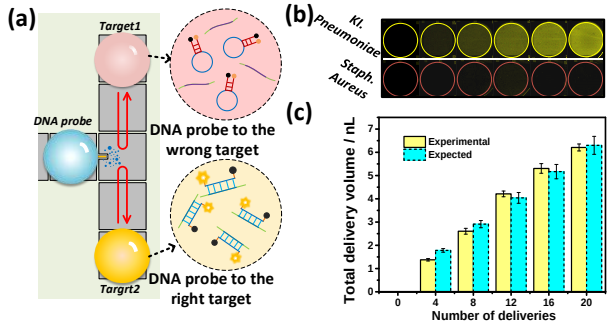

Figure 2. DNA identification on chip. (a) Process of DNA identification. (b) Fluorescence changes during deliveries. (c) Expected and Experimental Values of delivery Volume.

Acknowledgements

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