



Robot-on-a-chip

- Part 1: On-chip Generation of Droplets and Size Control -

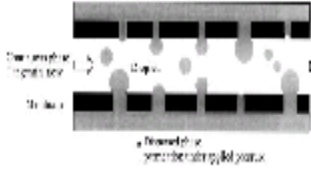
Lin Feng*, Yoko Yamanishi**, Tomohito Kawahara***, Masaya Hagiwara***, Kazuhiro Kosuge*, Fumihito Arai***

* Tohoku University, ** JST PRESTO, *** Nagoya University

オンチップで任意サイズの液滴を自動生成するには？

1. Background

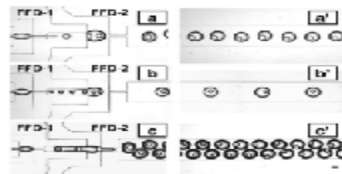
Emulsification



J. Chem. Technol. Biotechnol 79: 209-218 2004

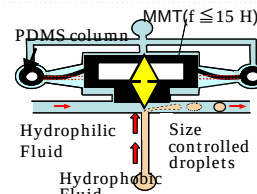
Conventional Design

Passive Droplet dispensing



(By changing Flow Rate)

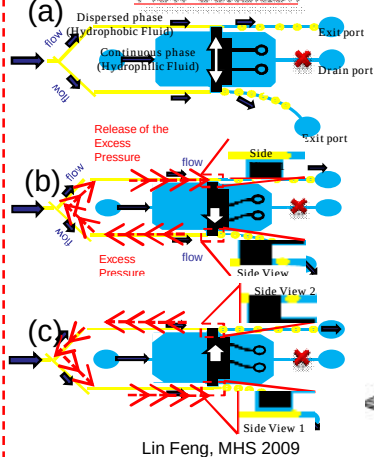
Problem of Conventional Droplet Dispensing



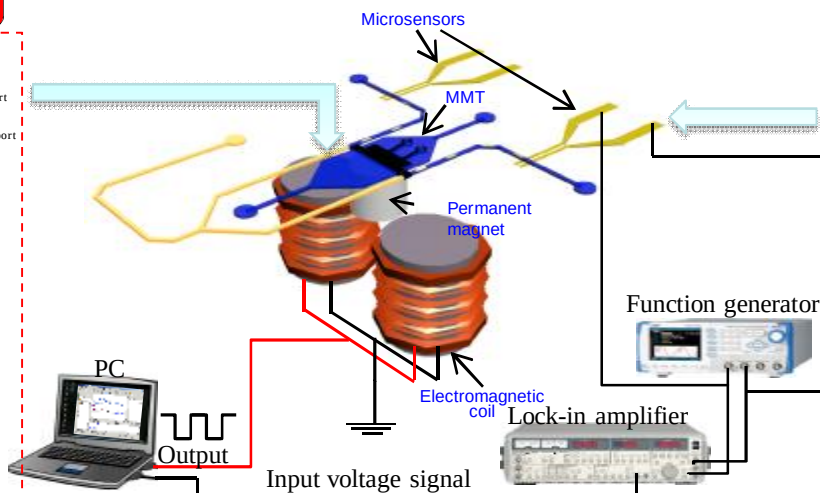
1. The size control is hard to achieve.
2. High-speed size adjustment is also a problem.

2. Concept

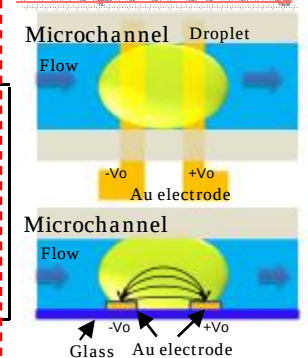
Flow Condition



Lin Feng, MHS 2009



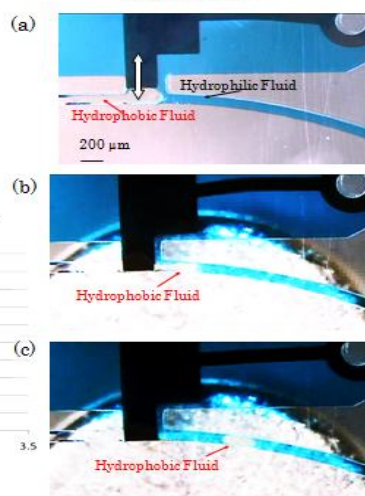
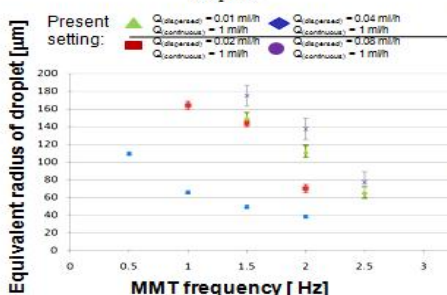
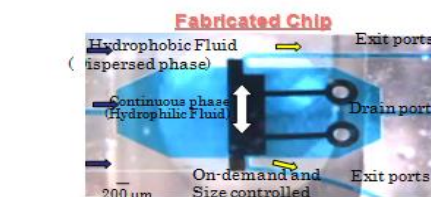
Principle of Sensing



3. Experiment

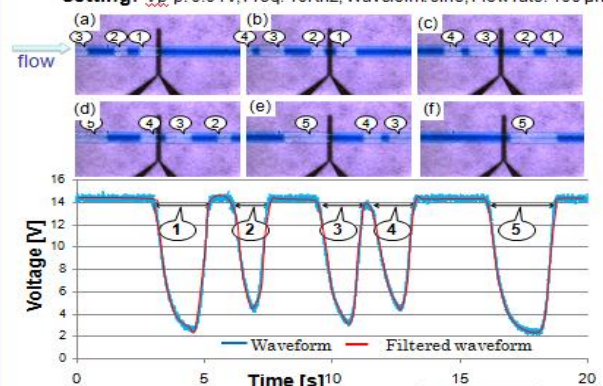
Droplet Generation

MMT in 1 Hz



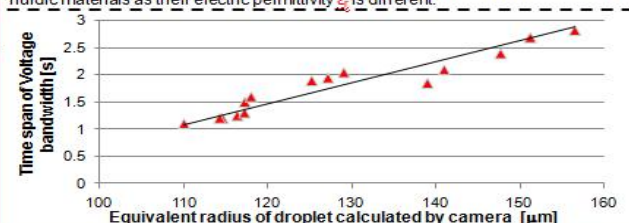
Sensing result of droplets

Setting: $V_{dp} = 0.01 \text{ V}$, Freq: 10KHz, Waveform: sine, Flow rate: 400 $\mu\text{m/s}$



$$C = \frac{Q}{2V_0} = \frac{2\epsilon_0 \epsilon_L}{\pi} \ln \left[\left(1 + \frac{w}{a} \right) + \sqrt{\left(1 + \frac{w}{a} \right)^2 - 1} \right]$$

Where Q is the total charge on a single electrode, and V_0 is constant potential held at the electrode pair, ϵ_0 is the vacuum permittivity, L is the length of the electrode pair, w is an electrode pair of finite width. So the capacitance will change by different fluidic materials as their electric permittivity ϵ_L is different.



4. Conclusion/Future work

We have successfully realized an active size controlled and on-demand droplet generation by using MMT. Through the expansion of closed-loop control with microsensor, it will be possible to realize automatic generation of size controlled droplets with high accuracy.

本研究は、JST-SENTANの助成を得て行われたものである。

本研究に関するお問い合わせ先: 馮 林 (Lin Feng)

E-mail: f.lin@biorobotics.mech.nagoya-u.ac.jp, URL: <http://www.biorobotics.mech.nagoya-u.ac.jp/>, TEL: 052-789-5656, FAX: 052-789-5213

〒464-8603 名古屋市千種区不老町 名古屋大学大学院工学研究科 機械理工学専攻 新井研究室

