Electronic Supplementary Material (ESI) for Lab on a Chip.

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Acoustofluidic actuation of *in situ* fabricated microrotors

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1. Frequency range of microrotors

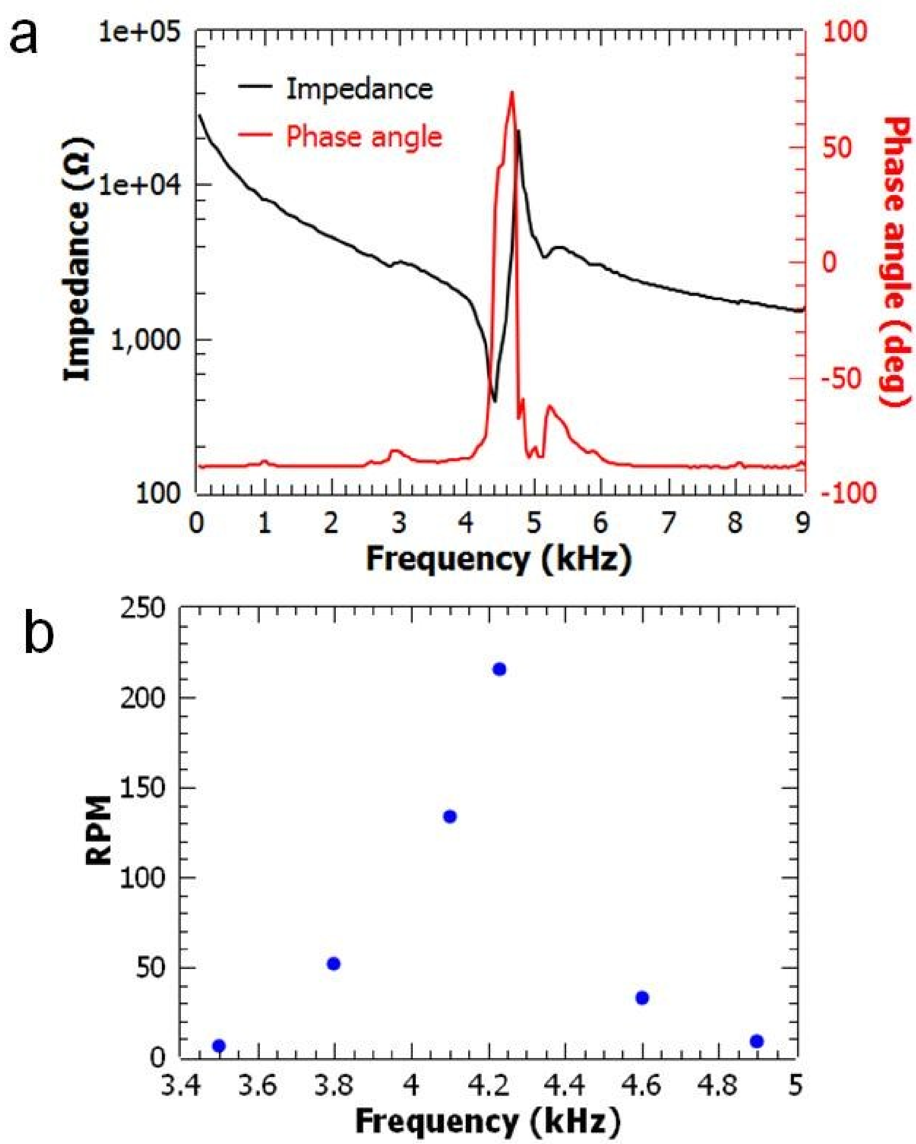

Figure S1: Resonance frequency analysis of a bonded transducer. (a) Impedance and phase angle measurements of the bonded transducer yield a resonant frequency of 4.41 kHz. (b) Dependence of the rotational rate of a one-arm microrotor to the frequency shows a maximum performance at around 4.25 kHz.

Figure S1 shows 1-arm microrotor's optimum frequency near 4.3 kHz. This is in a good agreement with the resonance frequency (4.6 ± 0.5 kHz) of the driving transducer. For the rest (from 2-arm to 6-arm microrotor), optimum frequency was slightly tuned (4.3 ± 0.3 kHz) due to imperfection in both fabrication and position of the transducer. The frequency range for each microrotor is still in the resonance frequency range (4.6 ± 0.5 kHz).

Table S1. Comparison of the existing microrotor performances.

Actuation	Fabrication	Speed
Hydrodynamic[1]	UV polymerization	650 RPM per flow rate of 130 μl/min
Laser manipulation[2]	UV polymerization	60 RPM at 2 W laser power
Bacterial motion[3]	lithography	6 RPM
Magnetic[4]	lithography	800 RPM
SAW[5,6]	lithography	~2000 RPM
Electro-chemical[7]	mechanical cutting	1 RPM

2. Video Captions

Video 1: Fabrication of a microrotor

A 5-arm microrotor is shown to demonstrate the fabrication process. By exposing UV light under the channel for 50 ms, any shape which is printed on photomask (5-arm microrotor in video S1†) can be obtained. The height of the microrotor is a few micrometre less than height of the microchannel due to incurable thin oxygen layer (~ 2.5 μm) on both bottom and top. Therefore, microrotors are loose enough to rotate freely.

Video 2: Performance of microtors with different number of arms

Comparison of rotational performance of the microrotors with the number of arms from 1 to 6 at 160 V_{pp}.

Video 3: Step-wise rotation of a microrotor

A 4-arm microrotor can rotate and stop almost instantly when acoustic field is turned on and off, which is due to low Reynolds number in our system.

Video 4: Control of angular speed by tuning the applied voltage

A 6-arm microrotor is shown to rotate under the applied voltage from 60 V_{pp} to 160 V_{pp}. As the applied voltage is increased, the angular speed increases as a consequence of stronger streaming flows at higher voltages.

Video 5: A simple mixing demonstration

A 6-arm microrotor is used to demonstrate mixing of pure ethanol and ethanol fluorescent bead solution that are injected into the microchannel side-by-side at a total flow rate of 10 µL/min. The mixing of the two flows occurs rapidly in under 30 milliseconds.

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