

## Research highlights

### Bioactuator: *Vorticella* actuation in microfluidic systems

*Vorticella* is a microorganism with a stalk capable of linear actuation with a 100  $\mu\text{m}$  working distance. Contraction and extension of the stalk are induced by  $\text{Ca}^{2+}$  (calcium ions) and chelators such as EDTA and EGTA. As the stalk does not require an external power source for actuation, it has intriguing possibilities for applications in microfluidic systems.

However, controlling *Vorticella* actuation in a microfluidic device remains a major challenge for these applications. Now Moeto Nagai and colleagues in Japan and Usa at Toyohashi University of Technology have demonstrated that pneumatically controlled microvalves can be used as a control system for the actuation of the stalk.

The experiments were conducted in three steps: microfluidic devices were fabricated by multi-layer soft lithography; the *Vorticella* were introduced and cultured in the device;  $\text{Ca}^{2+}$  and EGTA solution were injected.

The length of the stalks changed between 20 and 60  $\mu\text{m}$  in the presence of  $\text{Ca}^{2+}$  and EGTA, resulting in a working distance of about 40  $\mu\text{m}$ .

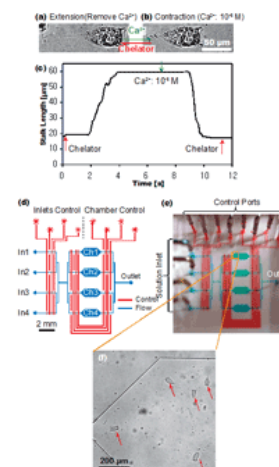
The stalks of *Vorticella* show genuine potential for applications in microsystems such as micro-positioners and microvalves.

#### Reference:

- Moeto Nagai<sup>1,2</sup>, Sangjin Ryu<sup>3</sup>, Todd Thorsen<sup>3</sup>, Paul Matsudaira<sup>3</sup> and Hiroyuki Fujita<sup>2</sup>
- Chemical control of *Vorticella* bioactuator using microfluidics
- *Lab Chip*, **10**, 1574–1578 (2010).
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Moeto Nagai



#### Enlarge Image

Figure caption: (a)—(c) Length change in a *Vorticella* stalk in a different  $[\text{Ca}^{2+}]$ . A rise of  $[\text{Ca}^{2+}]$  drives the stalk contraction. A removal of  $[\text{Ca}^{2+}]$  induces the stalk extension. (d) Structure and (e) picture of the microfluidic device. (f) Five cells of *Vorticella* cultured in the device.