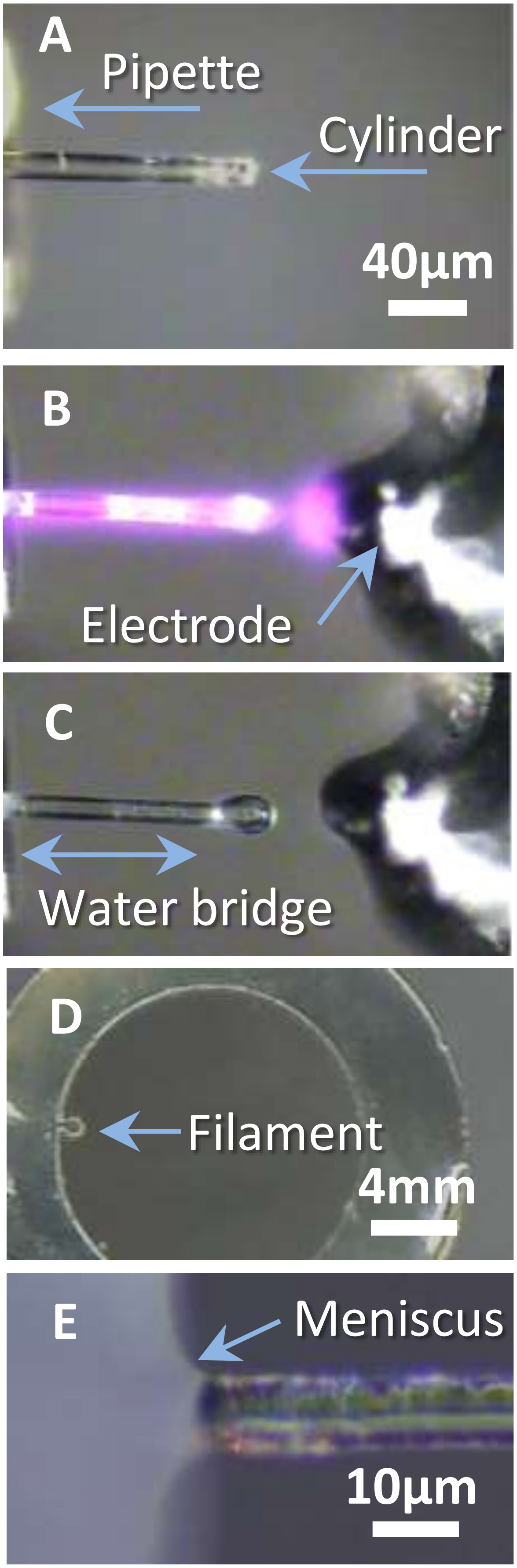

Supplementary Figure 1| Droplet fabrication. We first insert a silica cylinder into a pipette (a) while the pipette is full with water. We now apply voltage and increase it until break down generates plasma (b, purple). The plasma is turned off after 0.9 seconds. Lastly, we (c) apply low voltage to pull a droplet until all sides of the fiber end are wet and then turn the voltage off. A hydrophilic filament (d) inside the pipette enables the establishment of the left hand side of the water bridge. (e) Focusing on the left hand side of the water bridge reveals a meniscus shape typical for such boundaries.

Supplementary Note 1: Building the droplet fabrication setup

A silica fiber (Corning, SMF 28) is tapered to form a 10 µm diameter cylinder. The fiber stem is held in water between two glass microscope coverslips, leaving approximately 100 microns exposed to air, as seen in Fig.1a-b. The water between the coverslips assumes the role of the reservoir[2].

Voltage is applied by using two electrodes, one dipped in water (inside the pipette) and the other (platinum electrode) in air (Supplementary Fig. 1b). The voltage is increased until obtaining break down to plasma between the electrode and water (at about 1000 V/mm). The voltage is turned off about one second after the plasma is generated. The plasma modifies the contact angle between water and silica as described in[3]. The setup is now ready to provide micro droplets upon need, and the process described above, including the plasma treatment, should not be repeated.

Supplementary Note 2: Making a sustainable droplet

In order to pull a water droplet out of the pipette reservoir, we apply low voltage via the same electrodes used in the previous paragraph. This time, the voltage is kept below the threshold needed for plasma. The drop comes out of the pipette all the way to the end of the cylinder so that water fully covers the cylinder (Supplementary Fig. 1.c) and our device is bounded by free water walls from all of its directions except for the thin stem holding it. The droplet side that is closer to the pipette is water bridged to the pipette reservoir, and a water meniscus forms at the reservoir side of the bridge[4]. The voltage is now turned off and the drop is sustained (at zero voltage) as long as there is water in the feeding reservoir. To summarize this paragraph, making a sustainable droplet, as explained here, involves only turning on and off a relatively low voltage; which takes about a second to do.

Supplementary Note 3: Eötvös number

The Eötvös number is a dimensionless number relevant to our system that compares gravitational forces to surface tension[1]. Although gravity typically governs a liquid larger than a millimeter, surface tension normally dominates on a micrometer scale.

For an aquatic system like ours with a characteristic size (e.g. diameter) of 30 µm, the Eötvös number suggests that surface tension is 8250 times stronger than gravity. Therefore, water-walled microfluidics, such as presented here, might function as durable devices even at high accelerations of several Gs.

Supplementary Methods

Vertical and horizontal configurations were equivalent here, since gravity is negligible when compared to surface tension.

Supplementary References:

1. De Gennes P-G, Brochard-Wyart F, Quéré D. *Capillarity and wetting phenomena: drops, bubbles, pearls, waves*. Springer Science & Business Media (2004).

2. Michielsen S, Zhang J, Du J, Lee HJ. Gibbs free energy of liquid drops on conical fibers. *Langmuir* **27**, 11867-11872 (2011).

3. Sumner AL, *et al.* The nature of water on surfaces of laboratory systems and implications for heterogeneous chemistry in the troposphere. *Physical Chemistry Chemical Physics* **6**, 604-613 (2004).

4. Poincaré H. *Capillarité*. Gauthier-Villars (1895).