Electronic Supplementary Information (ESI) for Lab on a Chip

Two-dimensional droplet-based surface plasmon resonance imaging using electrowetting-on dielectric microfluidics

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S. Supplementary Information

S.1. EWOD Bottom plate fabrication

The bottom plate comprising of reservoir, path, and designated detection electrodes (Fig.1b) was fabricated on a clean 1.5" x 3" boro-aluminosilicate glass substrate onto which Cr (5 nm) and Au (100 nm) layers were deposited and patterned by standard photolithography and wet etching. This step defined the circular reservoir electrodes of 5 mm diameter as well as the interdigitated square actuation electrodes 1 mm in size with a 15 µm inter-electrode gap. A 2.5 µm thick negative photoresist (SU-8 GM1040, Gersteltec, Pully, Switzerland) was then spin-coated and exposed (350 mJ/cm^2, I-line, 365 nm) to insulate the control electrodes. Finally, a 30 nm thick film of 0.5% Teflon AF 1060 (DuPont, Wilmington, DE) diluted in Fluorinert FC-75 was spin-coated to make the surface hydrophobic. The devices were post-baked at 200ºC for 2 hours to fully cross-link the SU-8 dielectric and remove excess solvent from the Teflon film.

The distance between the bottom and the top plates was fixed at 150 µm by using a thick photoresist layer (SU-8 GM1070, Gersteltec) patterned so as to form a wall surrounding the active area of the chip.

S.2. EWOD coupling to SPRi

A feasibility study on the EWOD-SPRi integration has been performed. Fig.S1a shows the manipulation of a 1M K_2HPO_4 droplet between two detection sites as monitored by the SPR signal of the two spots chosen within the region of the detection sites on the top plate. From Fig.1d, the detection sites are aligned with the detection electrodes on the bottom plate, allowing droplet movement from one detection site to the next, by simply activating the actuation electrodes. Difference images showing droplet manipulation are illustrated in Fig.S1a with the corresponding SPR kinetic curves for the selected spots in Fig.S1b. The diameter of the spots was 98 µm and the spot location was selected such that "Spot 1" was initially inside the droplet (liquid medium), while "Spot 2" was outside the droplet (air medium). As the

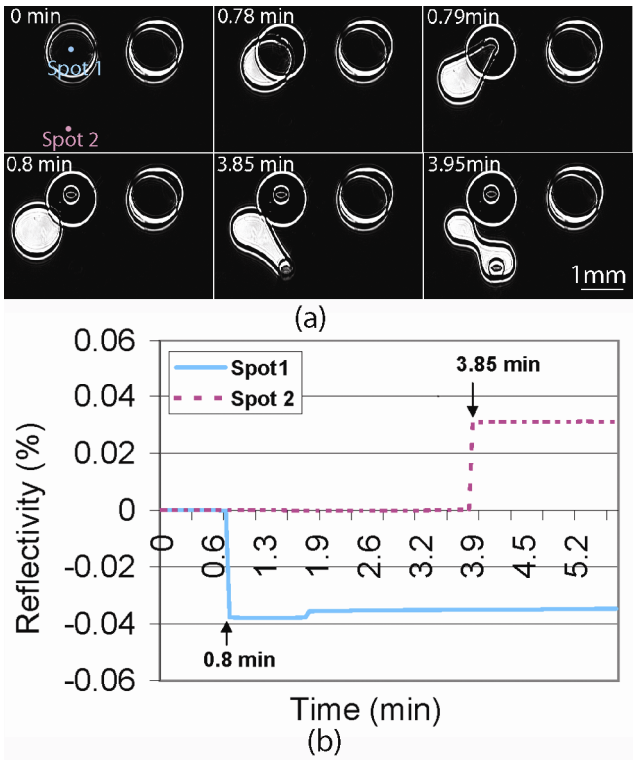

Fig.S1 (a) SPRi difference images of the droplet movement as a function of the activated electrodes (b) SPR kinetic curves for the selected spots exhibiting signal change as a function of the droplet wetting of the top plate with sequential electrode activation

voltage of 90V was applied to the specific actuation electrodes, the droplet moved from the spot1 to to that electrode, thus covering the activated region. The resulting shape and position of the droplet was monitored using SPRi on the region of the top plate in contact with the droplet, which also experienced a change in the wetting. Consequently, the chosen spots on the top plate changed the media (from liquid to air or vice-versa) resulting in SPR signal change. For instance, at time <0, all electrodes were deactivated, the droplet was covering spot 1 detection region, and the difference image was completely dark. After 5-10 seconds, the rim of the droplet appeared on the difference image, conveniently showing the droplet's initial position. Once the first path electrode was activated (time = 0.78 min), the droplet started to move to the activated area. At time t=0.8 min, the droplet completely moved away from the hydrophilic detection spot region (Spot 1). The droplet movement and the resulting shape are indicated on the difference images by the

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white regions (Fig.S1). As a result of droplet movement, "Spot 1" changed the medium from liquid to air, thus the respective kinetic curve experienced a drop the SPR signal (Fig.S1b). At a later time (t=3.85 min), the droplet was moved to spot 2, which changed the medium from air to liquid and experienced a rise in the SPR kinetic signal. It is noteworthy that prior to and following the droplet movement, the kinetic signals remained stable. Thus, the applied voltage did not have an effect on the integrity of the kinetic signal which remained constant under an applied voltage between electrode switching. The e-field was on the order of $2x10^{-4}$ V/m,[1] and could not influence the spectra of Au film itself.[2] This is important, as it allows SPRi monitoring of reactions under an applied voltage, thus enabling the coupling with the EWOD microfluidic device.

1. I. Barbulovic-Nad, H. Yang, P. S. Park and A. R. Wheeler, *Lab Chip*, 2008, **Advance article**, XX.
2. R. J. Heaton, A. W. Peterson and R. M. Georgiadis, *Proceedings of the National Academy of Sciences*, 2001, 071623998.