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EWOD-based Sensor Applied to Immediate Environmental Impact Diagnosis Through Analyte-Mediated Surface Tension Change

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Introduction

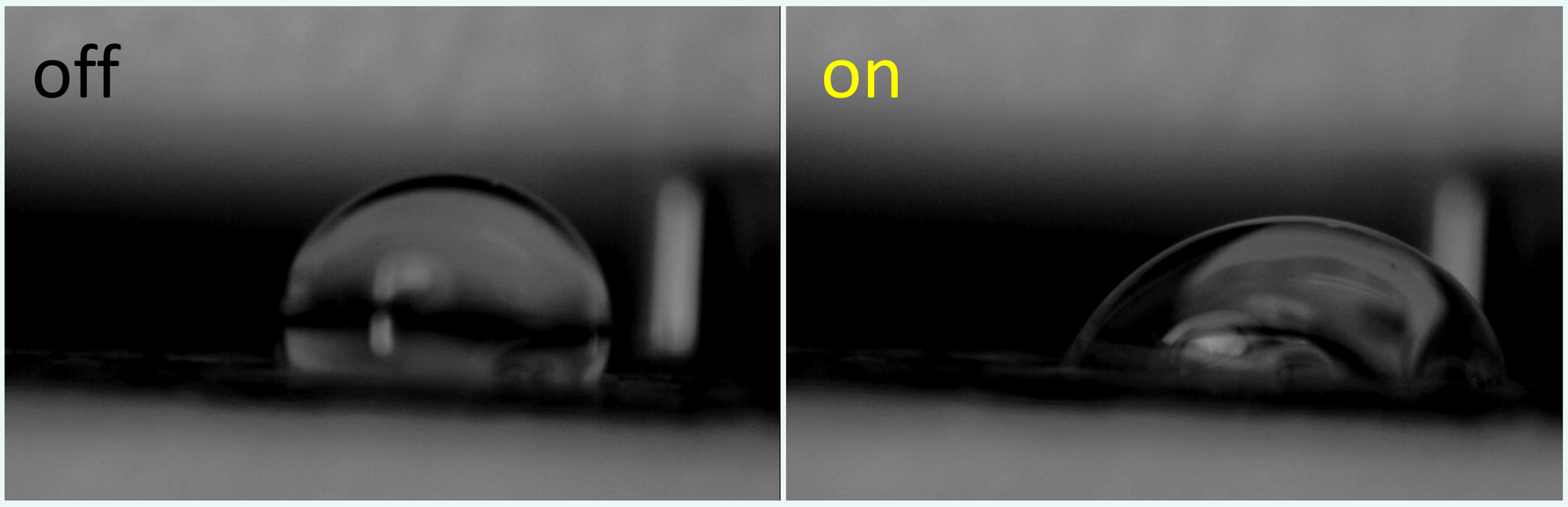
Electrowetting-on-dielectric (EWOD) devices are microfluidic systems that employ electrostatic forces to manipulate and control individual droplets. These devices enable precise handling of liquid volumes on a small scale, making them suitable for various scientific applications.

Exploring the EWOD effect on different substances in solutions offers the potential to design detection devices, leading to a new detection concept based on the quantification or analysis of the solutions' surface tension.

Background

Layers of the EWOD device prototype

The device fabrication consists of 4 layers: Cellulosic substrate, conductive layer formed by inkjet printing of Ag nanoparticles, and dielectric and hydrophobic layers applied via spin-coating.



Sagittal image of a droplet on the device, without applied voltage and with applied voltage

When a voltage is applied to the electrodes, an electrostatic alteration is induced, leading to a change in surface tension on one side of the droplet, which in turn causes the droplet to move over the surface of the device.

$$\cos\theta_v + \cos\theta_0 = \frac{C}{2\gamma}V^2$$

θ_v= contact angle post-voltage
θ_0= contact angle pre-voltage
C= Capacitance
V= Voltage applied
γ= Solution Surface Tension

The change in the contact angle of a solution droplet on the device upon activation can be analyzed, facilitating the determination of the solution's surface tension.

Aim: Developing a Surface Tension Sensor

- Alterations in surface tension within a solution are induced by the presence of diverse amphipathic substances. These changes in surface tension are found to be directly proportional to the concentration of the respective substance.
- Employing this innovative detection concept offers numerous applications in the fields of biomedicine and environmental diagnostics.

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