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SUPLEMENTARY INFORMATION

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1. Impedance fitting

Experimental spectra were fitted to the equivalent circuit presented in Figure 3A.

The contact resistance, R_c corresponds to the intrinsic resistance of wires and collector bars that form the interdigitated electrodes. The geometrical (stray) capacitance, C_G , mainly depend on the sensor geometry (the width of electrode, the length of electrode, the distance between two consecutive electrodes and the number of electrodes) and dielectric constant of the medium (water) in contact with the sensor. Both parameters are determined from the initial clean sensors spectra. As they do not depend on the surface modifications, once determined for each sensor these parameters were used as fixed in experimental spectra fitting, with typical values of 120 Ohm and 65.5 pF, respectively.

The fitting quality was evaluated using chi-squared values calculated as the square of the standard deviation between the original data and the calculated spectrum. In all fittings performed the Chi-square values were lower than 10^{-4} which reflects the correctness of the chosen equivalent circuit. Along with R_c and C_G , the fitting results give the values of R_s and CPE, which represents the double layer/interfacial capacitance. The impedance of the CPE element may be expressed as:

$$Z_{CPE} = \frac{1}{(j \,\omega)^{\alpha} K} \tag{1}$$

were $j=\sqrt{-1}$ (imaginary unit); ω is angular frequency (rad·s⁻¹); *T* is expressed in F cm⁻²·s^{α -1} with C_{DL} (F), the capacitance of the double layer, and α is an empirical constant representing the behavior of the CPE. When the exponent α is equal to 1 the CPE behaves as an ideal capacitor. Typical CPE_{DL} values of α in our measurements this value was typically within 0.75 - 0.85 range.

It must be noted that the double layer capacitance depends on various factors that include surface or zeta potential, solution electrolyte concentration, presence of adsorbed species, etc.

2. PDMS with p(NIPMAM) microgels

The diameter of employed p(NIPMAM) microgels is around 200 nm in aqueous solution, but after the sample treatment for observation in SEM the size is considerable smaller. SEM images demonstrate that the microgels are satisfactorily immobilized on the flat PDMS stamps



Figure S1: SEM images with p(NIPMAM) microgels on a PDMS stamp surface at different magnifications, x 20000 (A) and x 40000 (B).

3. Dynamic Light Scattering (DLS)

Experimental

The hydrodynamic radius, R_h and particle size distribution experiments of the microgels were performed on a Zetasizer Nano-ZS (Malvern Instruments, Worcestershire, U.K.). Temperaturedependent measurements were recorded at a fixed scattering angle of 173° and a wavelength λ =633 nm of the laser beam while the temperature was varied in the range of 30 °C to 60 °C at 2 °C intervals and with a measurement time of 10 s and 11 runs, performed in triplicates. The samples were highly diluted to avoid multiple scattering. For data evaluation, the cumulant fit analysis was used and the hydrodynamic radius R_h calculated by use of the Stokes–Einstein equation.

Results and discussion

The temperature response of p(NIPMAM) microgel in aqueous suspension is shown in Figure S2 in which it can be observed that the volume phase transition occurs at 45°C. All the experiments of this work have been performed at room temperature (25°C). Under this conditions the hydrodynamic radius is around 100 nm and, consequently, the diameter of microgels in aqueous solution is around 200 nm.



Figure S2. Temperature response of P(NIPMAM) microgel, hydrodynamic radius R_h of P(NIPMAM) as a function of temperature, with a volume phase transition temperature (VPTT) at 45 °C.

4. Confocal laser microscopy scanning (CLSM) imaging

A) Study of bacteria distribution at the 3D-IDEA surface

Confocal laser microscopy scanning (CLMS) images of the electrode surfaces were acquired to compare the bacteria distribution of *E. coli* immobilized on the 3D-IDEA surface under different experimental conditions. In the case of low bacterial concentrations (10⁵ and 10⁶ CFU/mL) Live/Dead images obtained after 20 and 60 minutes of deposition showed very low bacteria presence on the sensors surface. As reveal CLMS images in Figure 3a only few bacteria were observed on sensors treated with 10⁶ CFU/mL after 60 minutes non-specifically distributed on the top of barriers as well as within the trenches.



Figure S3a. Confocal images of bacteria on the 3D-IDEA sensor surface corresponding to the top of barriers (A) and the trenches (B) after the immobilization during 60 minutes of *E. coli* ATCC 25922 bacteria at 5×10^6 CFU/mL stained with Live/Dead reagent (live bacteria appear green and dead bacteria appear red).

The results of sensors treatment with bacteria concentration of 10^7 CFU/mL during different incubation time (20 and 60 minutes) are presented in Figure S3b. A final washing step was applied to remove loosely attached cells from the surface. After 20 minutes the majority of bacteria were found within the trenches, and just a few numbers remained on the top of the barriers. On the contrary, after 60 minutes of incubation a large amount of microorganisms were observed on top of the barriers as well as in the trenches. In all the cases it was observed that after 60 minutes the drop of 10 µL of KCl solution containing *E. coli* bacteria was completely evaporated.



Figure S3b. Confocal images of bacteria of the 3D-IDEA sensor surface corresponding to the top of barriers (A, C) and the trenches (B, D) after the immobilization during 20 and 60 minutes of *E. coli* ATCC 25922 bacteria at 5×10^7 CFU/mL stained with Live/Dead reagent (live bacteria appear green and dead bacteria appear red).

B) Effect of ampicillin in E. coli cells within the trenches

CLMS images were also obtained on the 3D-IDEA with *E. coli* within the barriers after the assays with ampicillin monitoring the impedance changes. The Live/Dead experiment confirms that after 6 hours bacteria are dead as a result of bacteriolytic effect of ampicillin on bacterial cells.



Figure S4. CLMS images of bacteria stained with Live/Dead reagent on the 3D-IDEA sensor surface corresponding to the top of barriers (A) and the trenches (B) after the impedance measurements during 6 hours (live bacteria appear green and dead bacteria appear red).

5. Growth curves of E. coli strains with ampicillin

The bacterial growth was tested using standard protocols with the resistant and sensitive *E. coli* strains to ampicillin at 10mg/L.



Figure S5. A) Bacterial growth of *E. coli* ATCC 25922 with and without ampicillin. B) Bacterial growth of *E. coli* ATCC 25922_GFP (resistant to ampicillin) with and without ampicillin.