Electronic Supplementary Material (ESI) for Soft Matter.

Programmed topographical features generated on command in confined electroactive films

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Supporting Information

Supplementary Note 1

We have performed finite element simulations to predict the deformation mechanics and gain more insight into the surface dynamics. For this study, we used Marc Mentat coupled electrostatic-structural analysis. In the simulations, the electrode thickness was set at 10 nm for E0 and 100 nm for E1. Both the glass and the patterned electrodes E1 are rigid (infinite stiffness) and static. The flexible (finite stiffness) and dynamic media above the electrodes is defined as a Neo-Hookean type material with the viscoelastic and damping properties as obtained from rheology oscillatory frequency sweeps. The program ‘Viscodata’ was used to convert the frequency-dependent storage modulus to a 5-term prony series, which can be inserted into Marc Mentat to define the viscoelastic properties. The oxidation layer is modeled as an 11 nm thick elastic-plastic isotropic material with Young’s modulus of 4.93 MPa, as determined from AFM measurements. The presence of this layer does not influence the simulated dynamics of our coating. The top electrode is modeled with the material properties of gold. The elements of all materials are assigned to contact bodies and the corresponding contact interactions are defined as ‘glued’ and ‘permanent’. All static elements are assigned to element type 7 (Hexagonal, Full integration) and all dynamic elements are assigned to element type 84 (Hexagonal, Full & Hermann Formulation). The electric field is applied via the driving scheme (Figure 1c) where the potential between E0 and E1 switches between 0 and 150 V as a function of time. The kinetics of the deformation was determined by tracking the ΔZ displacement of the nodes at the surface above the electrodes during the simulation.

Supplementary Note 2

The FEM simulations also provide an opportunity to analyze dynamic textures that are challenging to create experimentally. For example, the CC1 and CC2 textures can be combined in a single coating by using two ITO electrodes. In this setup, neighboring rings can be addressed consecutively in a tri-electrode setup similar to the one used in our previous work. During activation of the electric field, the initially flat coating deforms and continuously switches between the CC1 and the CC2 texture, rather than just oscillating in height (Figure S1a). Another example is the inversed ArC texture where ITO circles are used rather than circular holes in the ITO electrode. Now, an array of valleys is created instead of hills (Figure S1b). In both examples the only challenge remains the addressing of each ring or circle within the circuit. It might be possible to address multiple ITO electrodes from underneath the surface like a microchip.

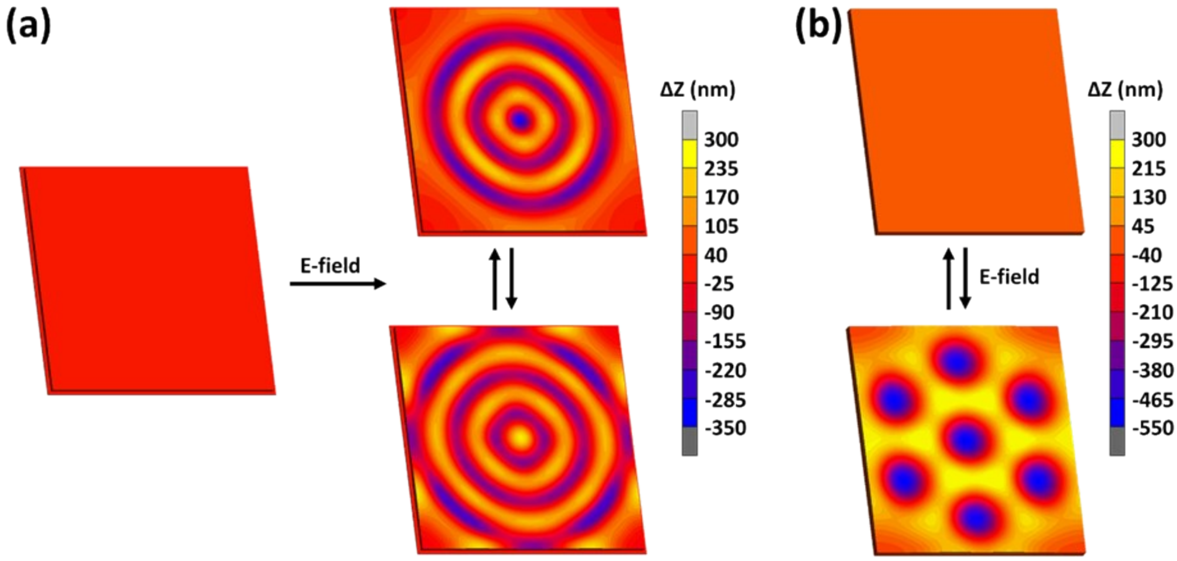

Figure S1. Predictions from FEM simulations for systems that are difficult to create experimentally. (a) When using a pattern of concentric circles, it is possible to create oscillating rings from an initially flat surface if two ITO electrodes are used to address neighboring rings consecutively. (b) Instead of an array of holes in the ITO electrode, it is possible to use an array of ITO circles to crease valleys rather than hill on the surface.

Supplementary Note 3

The 3D DHM images of the coatings with the CC1 pattern (Figure S2) are similar to the images with the CC2 pattern (Figure 3a) and therefore moved to this section.

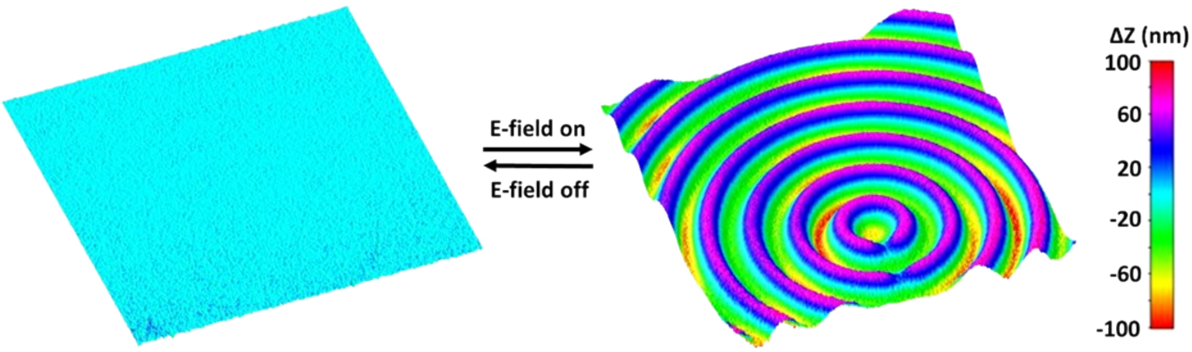

Figure S2. 3D DHM images of the flat and corrugated surface consisting of concentric circles with a valley at the center (CC1)