DYNAMIC TEMPLATING OF COLLOIDAL PATTERNS IN THREE DIMENSIONS WITH NONUNIFORM ELECTRIC FIELDS: SUPPLEMENTARY INFORMATION

SUPPLEMENTARY INFORMATION 1: MOVIE 1

The movie shows the transient dynamics after the a.c. electric field (f = 100 kHz) is turned on in the bottom-stripe geometry, corresponding to the same conditions as for the still images in Figure 3. The instability where lines that form at the centre of the electrode is seen after frame number 25.

SUPPLEMENTARY INFORMATION 2: MOVIE 2

The movie shows dynamics after the a.c. electric field (f = 100 kHz) is turned on in the crossed-field geometry. In this case the presence of the crossed electrode provides a periodicity and hence a pathway for the instability (seen after about frame number 31).

SUPPLEMENTARY INFORMATION 3: FIGURE 1 SUPPLEMENTARY

A y-z cut of the ∇E^2 vector field. Only arrow heads are shown, color scale from blue (low magnitude) to red (large magnitude). For $K < 0$, the DEP force points in the direction opposite to ∇E^2. Numerical calculation carried out in Maxwell3D. The region chosen is in between two top electrodes. The region labeled "E" is at the middle of each bottom electrode (black line, 85 μm), and "C" is in between two bottom electrodes.

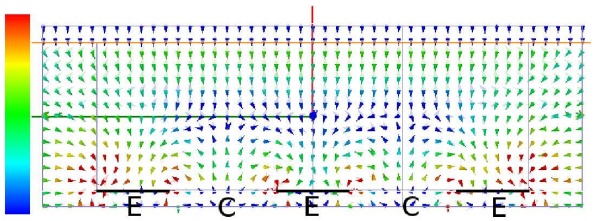


FIG. 1. SUPPLEMENTARY

SUPPLEMENTARY INFORMATION 4: MOVIE 3

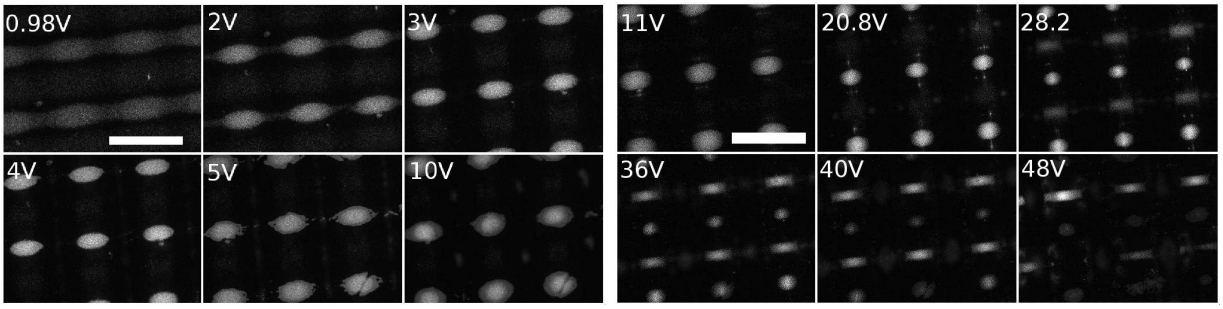
The movie shows a 3-dimensional scan (34 x-y slices with a z-step of 2 μm, scanned from top down) of (approximately 6.5 μm thick) colloidal structure near the bottom electrode in a non-aqueous suspension that exhibits positive DEP. Colloidal particles are 1μm in diameter, scale bar is 50 μm. The electrode (not seen) is a horizontal stripe with particles on its edge. The particle rich area is below the (vertical) top electrode. In the centre of the particle-rich area, one sees ordering due to dipole-dipole interactions.

SUPPLEMENTARY INFORMATION 5: FIGURE 2 SUPPLEMENTARY

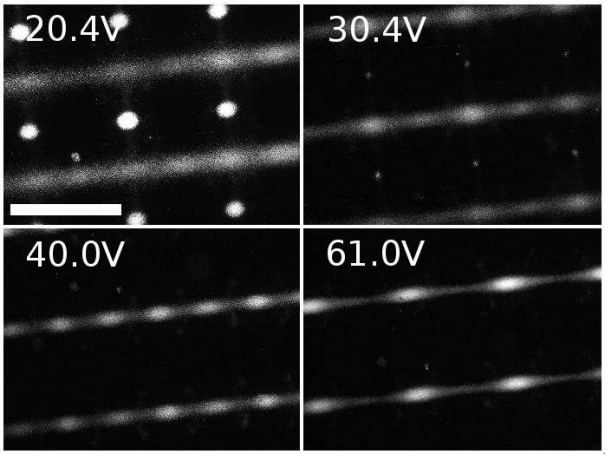
Field-dependence of particulate patterns at different frequencies. (a) f = 1 kHz. Particles are exclusively in the "E" position except at the highest voltage, where there are some particles in the "C" position. (b) f = 10 kHz. Particles are in both E and C positions. (c) f = 100 kHz. Particles are in both E and C positions, except at high fields where they are exclusively in between the electrodes, but elongated.

SUPPLEMENTARY INFORMATION 6: FIGURE 3 SUPPLEMENTARY

Other geometries (with larger non-uniformities) can give rise to faster dynamics. A patterned ITO substrate consisting of square ITO-free regions. a) Confocal micrograph of particles (green) and the patterned electrode (red). E=0. b-e) Time series of fluorescence micrographs of cell with a square patterned electrode (40X objective, NA=0.600). Scale bar: 49.7μm. $E_0 = 0.27$ V /μm, $f = 100$ kHz, $\phi \sim 0.4\%$, $\sigma = 0.8\mu$m.

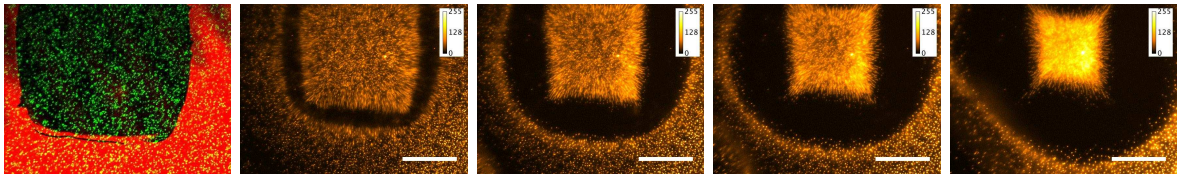


(a) (b)



(c)

FIG. 2. SUPPLEMENTARY. Scale bar is 250 μm.



(a) (b).76 s (c)1.14 .s (d)2.66 s (e)4.18 s

FIG. 3. SUPPLEMENTARY