Supplementary Information

Selective Adhesion, Restricted Growth, Proliferation Inhibition and In-Situ Transformation of Yeast Cells on Honeycomb-Patterned Polymer Film via Microemulsion Approach

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Experimental section

Preparation of DDDA decorated honeycomb-pattered film: To a 5 mL of dichloromethane was dissolved 30 mg of Polystyrene (PS; 349 kg mol^{-1}, Acros Organics) and 0.5 mg of Didodecyldimethylammonium bromide (DDDA; Aladdin). The organic solution was mixed with distilled water in a controlled volume ratio of 20:1 and then sonicated for 10 min to disperse water in organic phase, yielding a translucent white microemulsion. After filtering with 220-nm filter, 20 μL of the filtrate was cast onto a clean glass wafer under the relative humidity of 30–40% at 25–35^{o}C and the desired DDDA-modified honeycomb-patterned PS film was obtained with the evaporation of solvents. Following similar procedures, pluronic (PEO_{20}-PPO_{70}-PEO_{20}) (P123; Sigma Aldrich) instead of DDDA was used to fabricate P123 decorated honeycomb film as a

controlled experiment in the following steps.

Surface modification of DDDA decorated honeycomb-patterned film: Firstly, negatively charged poly(sodium-p-styrenesulfonate) (PSS; 70 kg mol^{-1}, Acros Organics) and positively charged poly(ethylenimine) (PEI; 750 kg mol^{-1}, Sigma Aldrich) were used as the building blocks to modify the DDDA decorated film. Briefly, PSS and PEI were dissolved in the mixture of distilled water and ethanol (10:1 volume ratio), yielding a solution with concentration of 1 mg mL^{-1}, respectively. The PSS layer covered on the positive charged DDDA decorated film was conducted by inserting the film into PSS solution for 30 min, rinsing three times with the mixture of distilled water and ethanol, drying at 40 ºC for 30 min. Then, the PEI modification was carried out by immersing the film into PEI solution for 30 min, and rinsing with the mixture of distilled water and ethanol, and again encountering a drying process. Each LBL-bilayer of DNA (Pps1303; Addgene) and PEI was assembled according to the steps described above. This cycle was repeated a number of times depending on the number of layers required. For fluorescent measurement, rhodamine-B isothiocyanate (RITC; Sigma Aldrich) labeled PEI was used instead as a positively charged building block to deposit on the film following the similar procedures. In addition, the P123 decorated film was also assembled with PSS and RITC-PEI as a control.

Cell adhesion and culture on honeycomb-patterned film: To 900 mL of water were dissolved 10 g of yeast extract (Oxoidltd Basingstoke Hampshire England) and 20 g of peptone and the solution was heated at 121 ℃ for 20 min. Then, 20 g of dextrose was added into the mixture to obtain the YPD media. Yeast cells were incubated in 20 ml of YPD media at 160 rpm for 16 h to prepare the stable-phase. The cell adhesion studies were performed by dropping the stable-phase yeast cell (4 mL) onto PEI modified film at 30 ℃. After 1 h of incubation, the film was rinsed four times with

phosphate buffered saline (PBS; PH 7.4, Sinopharm Chemical Reagent) to remove unspecific adsorbed yeast cells from the film. Then the film containing adherent yeast cell were incubated in 4 ml of fresh YPD media for 6−12 h at 30 ℃.

Cell viability test: The viability of the yeast cells on the patterned films was tested using fluorescein diacetate (FDA; Sigma Aldrich). The detailed procedure is that 10 μL of FDA in acetone solution with the concentration of 10 mg mL^{-1} was mixed with 0.49 mL of water and then dropped onto the surface of yeast cell contained film. After 20 min of incubation in dark, the patterned film was washed with water and then characterized through CLSM.

Cell transformation in the pores: Yeast cell containing film was immersed into 0.5M sodium chloride solution, followed by incubation at 45 ℃ for 45 min. Then the film containing adherent yeast cells were incubated in 4 ml of fresh YP + galactose media and shaked at 160 rpm and 30 ℃ for 48h.

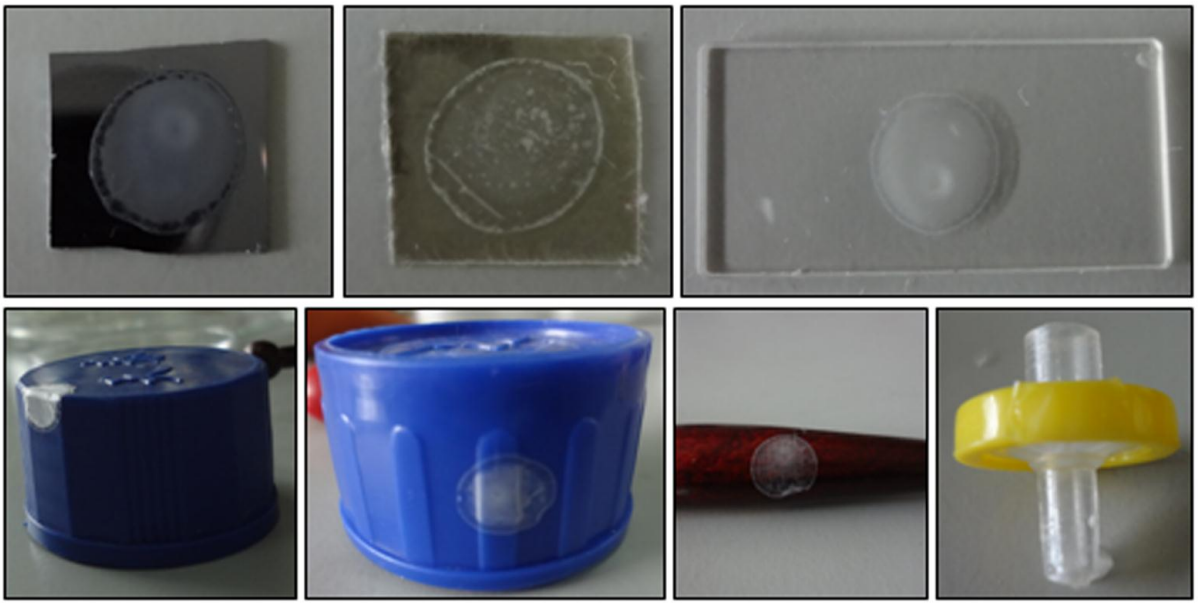

Figure S1. The DDDA decorated film after transferring to different kinds of substrate: the top ones are to flat substrates and the bottom ones are to arbitrarily shaped objects.

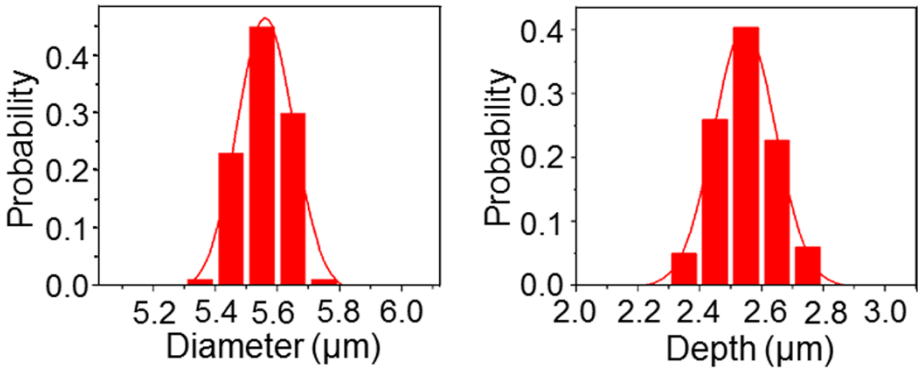

Figure S2. Histogram and Gaussian fit curves of the pore size (in total, 300 pores were counted) in Figure 1a.

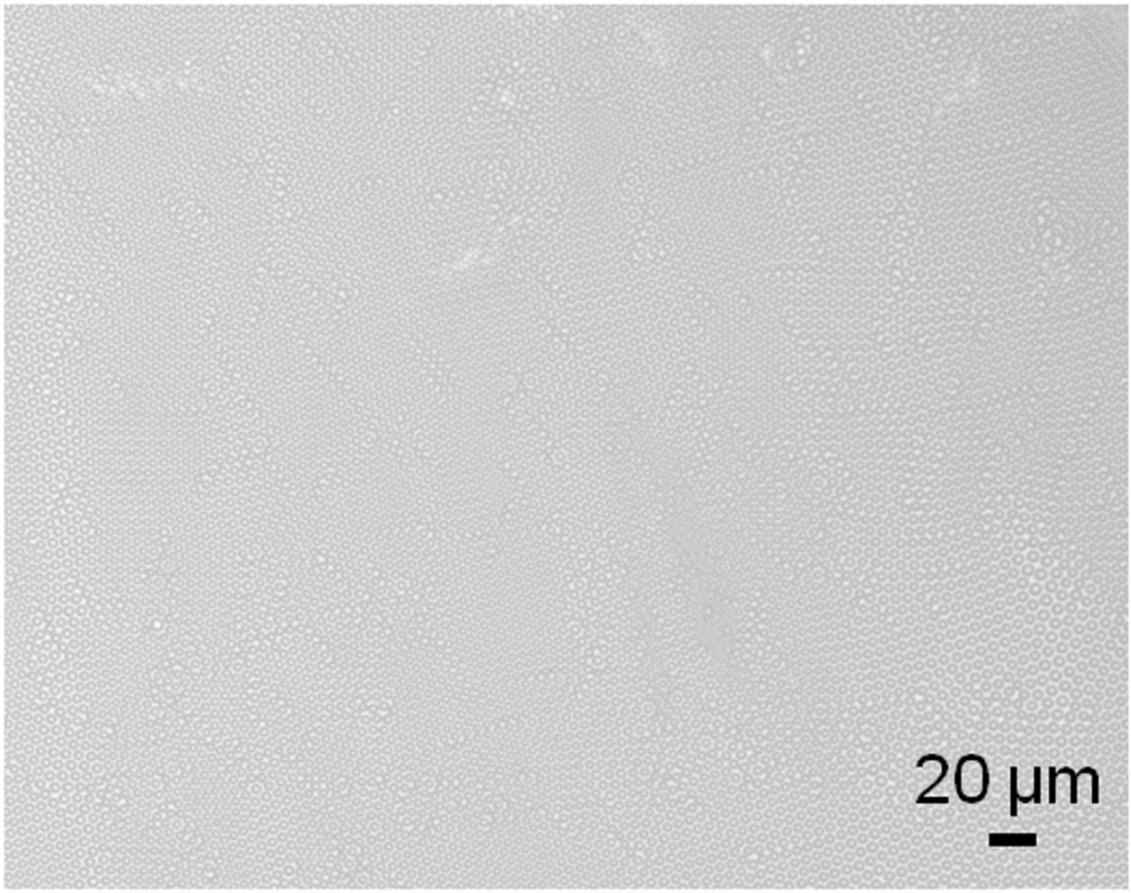

Figure S3. Optical image of the DDDA decorated honeycomb-patterned film.

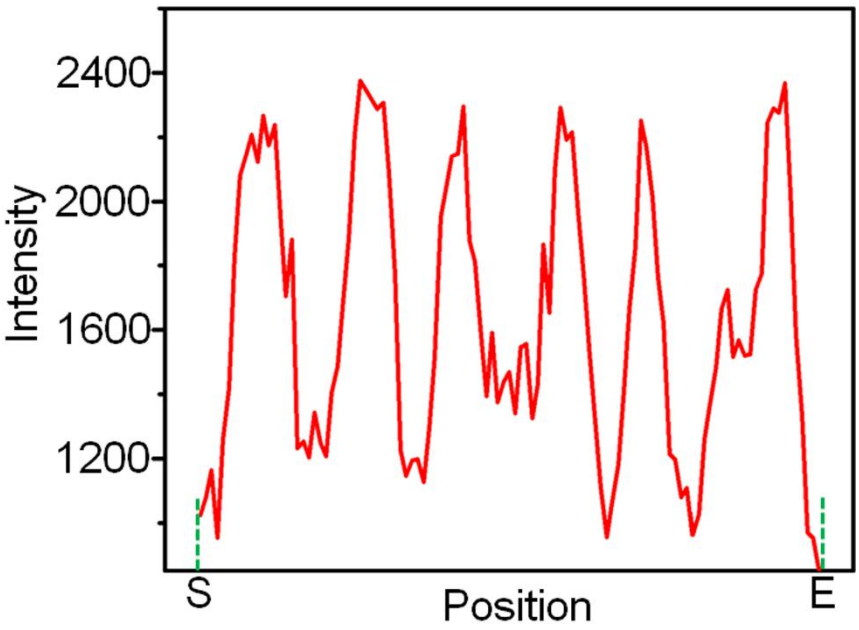

Figure S4. The line profile of fluorescence intensity for the selected pores in Figure 1b.

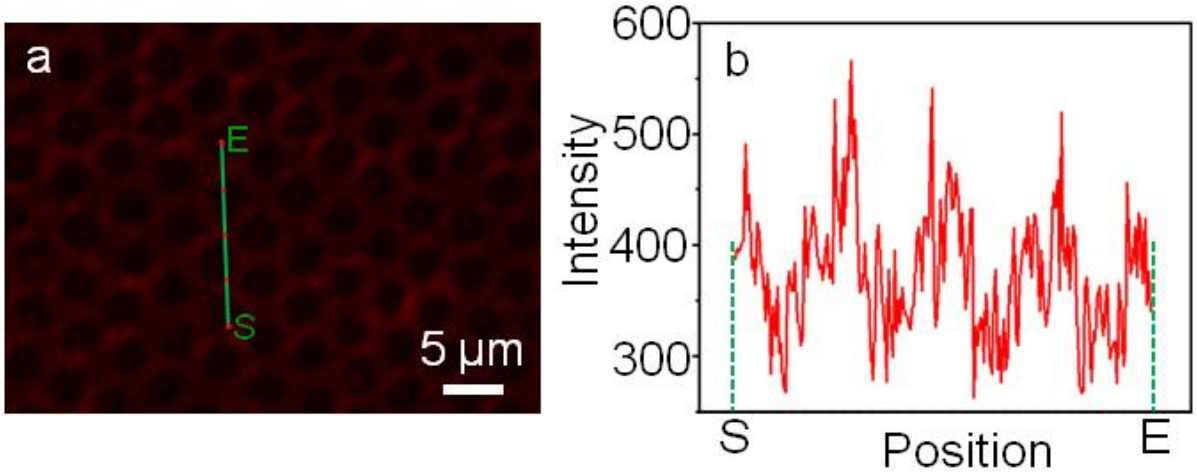

Figure S5. P123 decorated film after deposition with PSS and RITC-PEI: a) fluorescent image and b) line profile of fluorescence intensity for the selected pores.

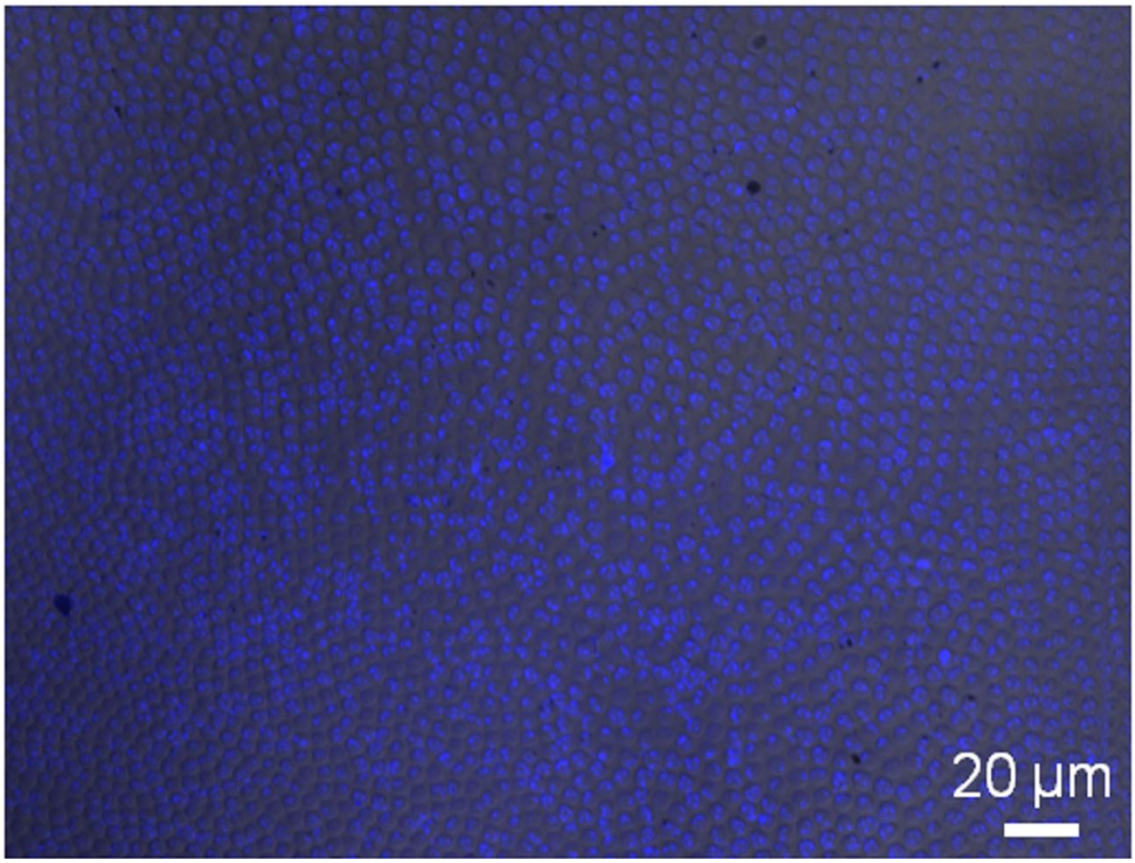

Figure S6. CLSM image of the film after cell adhesion under both optical and fluorescent mode.

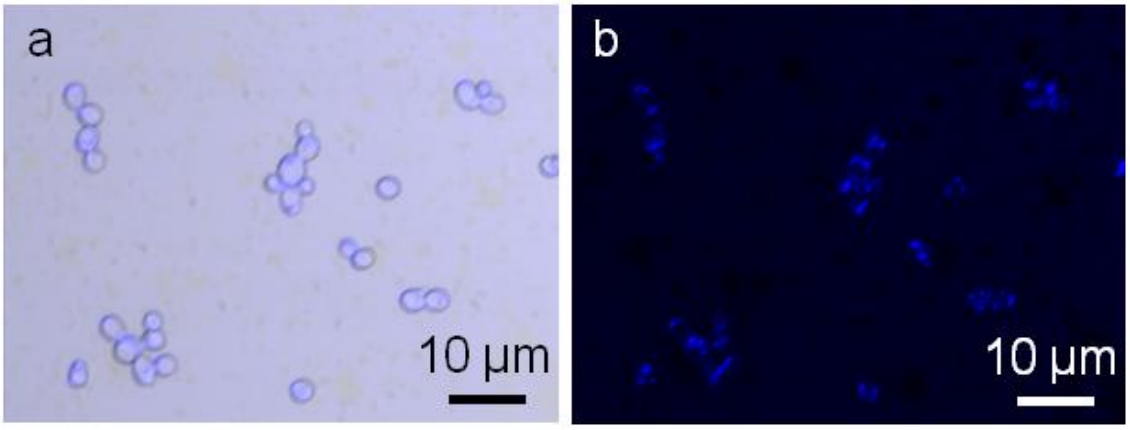

Figure S7. CLSM images of the DAPI labeled yeast: under a) both optical and fluorescent mode, b) fluorescent mode.

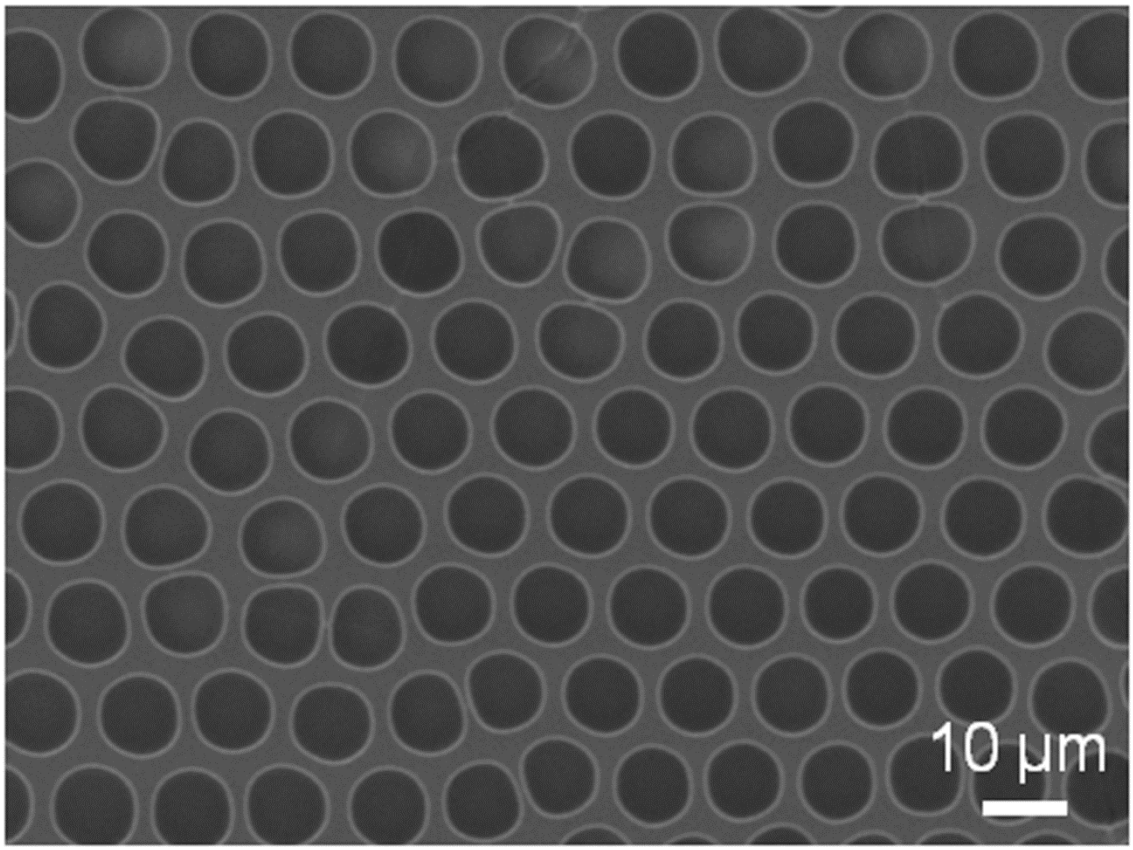

Figure S8. SEM images of DDDA decorated film after cell adhesion.

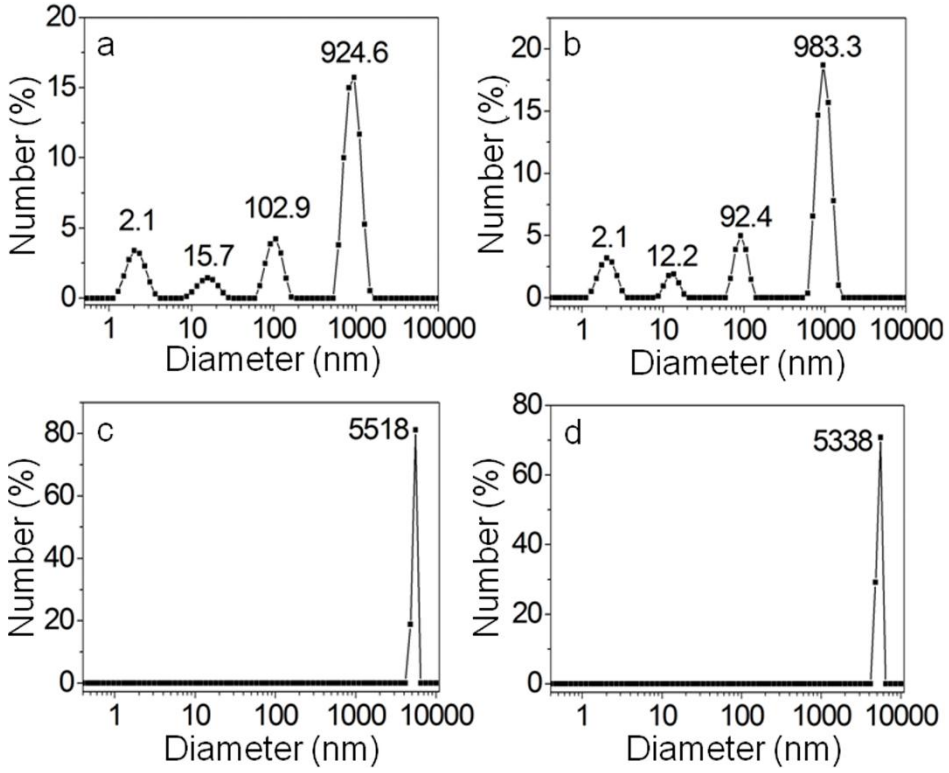

Figure S9. DLS diagrams of the a) solution after rinsing the film with cells grown for 12 h, b) culture solution of cell, c) cell containing solution after releasing from the pores and d) culture solution with cell.

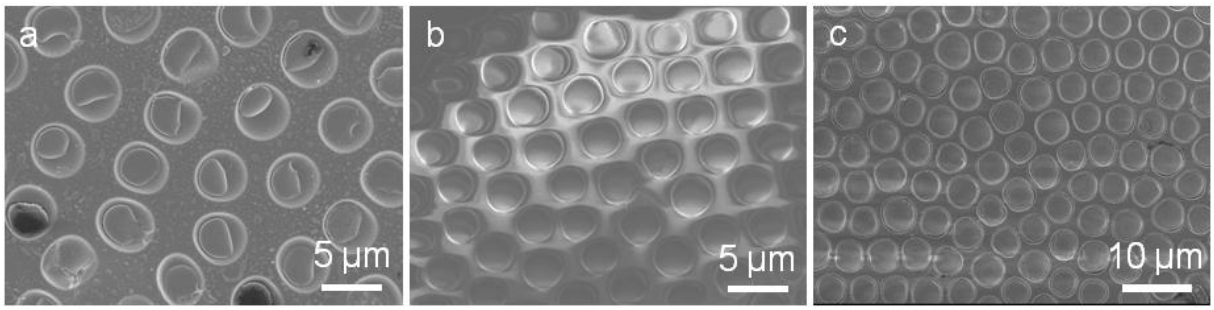

Figure S10. SEM images of the porous film with cells in 4 µm pores after culturing for a) 0 h, b) 6 h and c) 12 h.

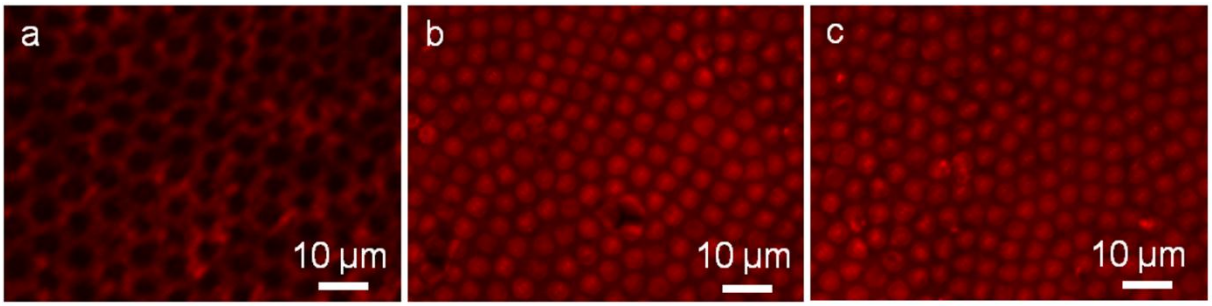

Figure S11. CLSM images of porous film after interact with RITC-PEI: a) without cell and with cells which were cultured for b) 6 hours, c) 12 hours.

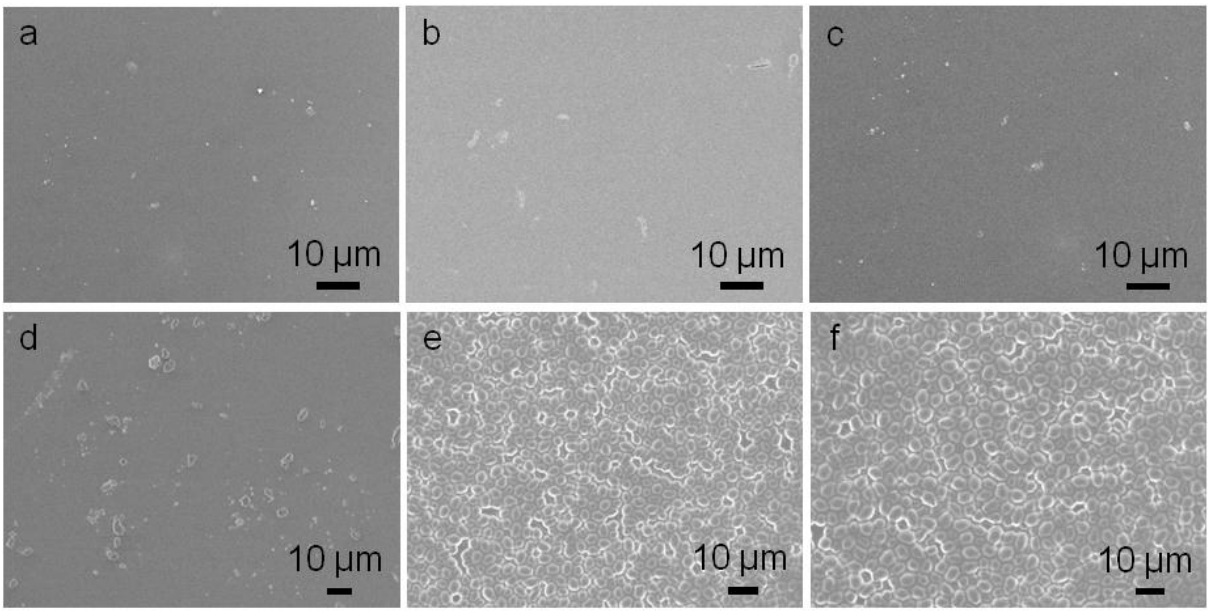

Figure S12. Flat a, b, c) PS and d, e, f) PEI film after cell adhesion (a, d), 6 h (b, e) and 12 h (c, f) culture steps.

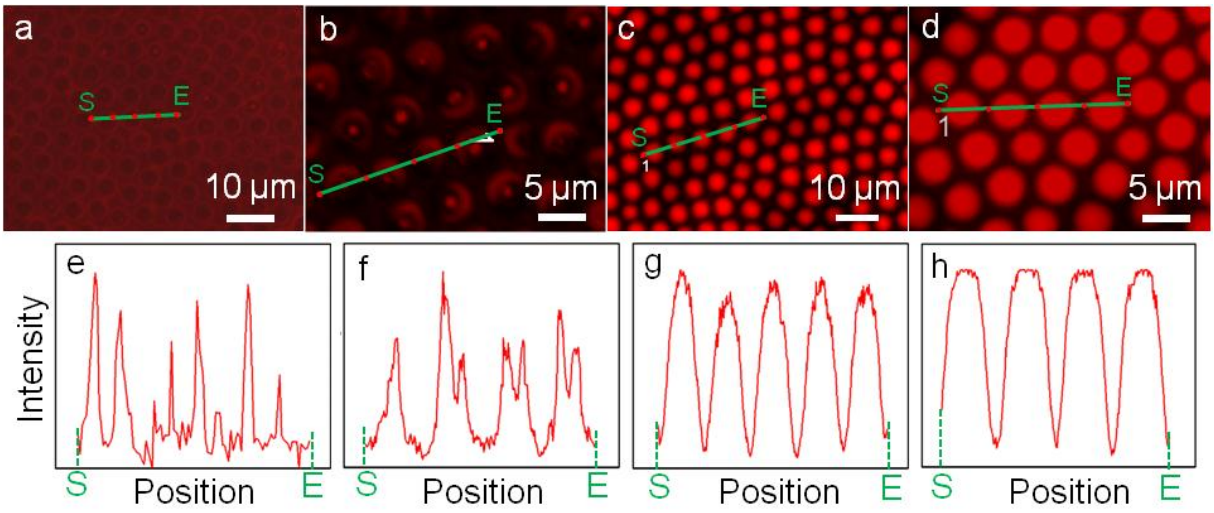

Figure S13. DDDA decorated film with different deposition (n): fluorescent images (n = 2 (a), 4 (b), 6 (c), 8 (d)) and the line profile of fluorescent intensity for the selected pores (n = 2 (e), 4 (f), 6 (g), 8 (h)).

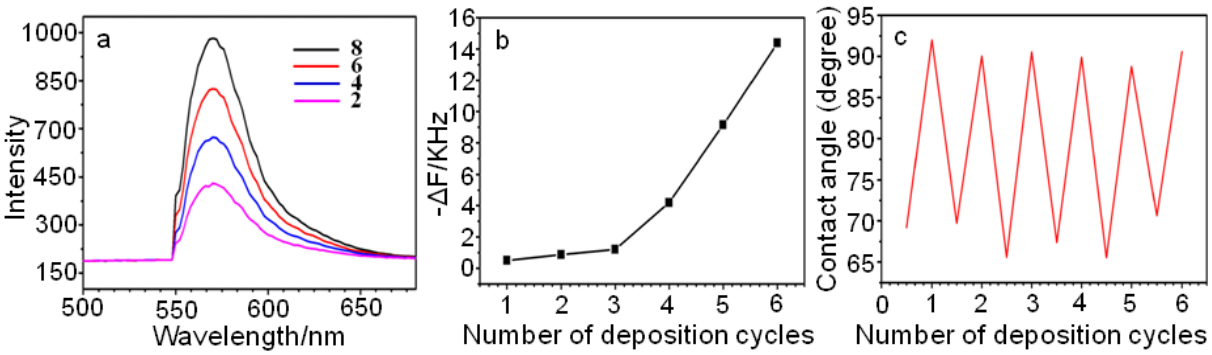

Figure S14. a) Mean fluorescence intensity, b) frenquency reduction and c) contact angle of DDDA decorated film with different deposition cycle.

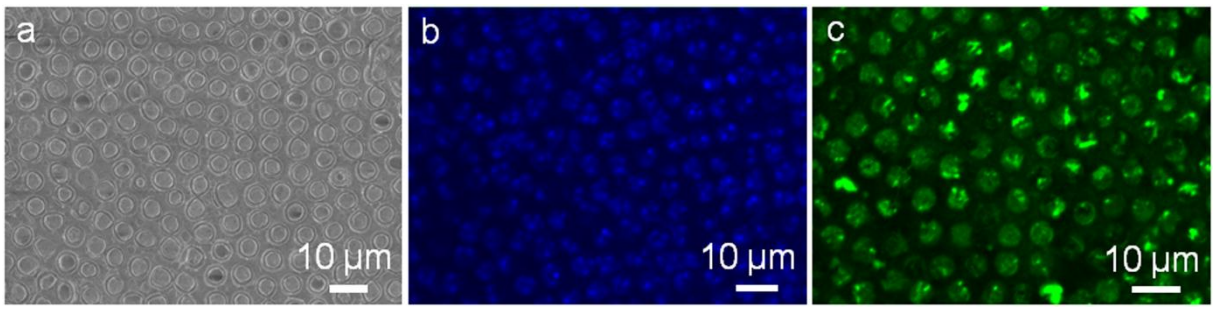

Figure S15. a) SEM and b) CLSM images of DNA/PEI assembled film after DAPI labeled yeast cell adhesion, and c) yeast cell adhesive film after FDA test.

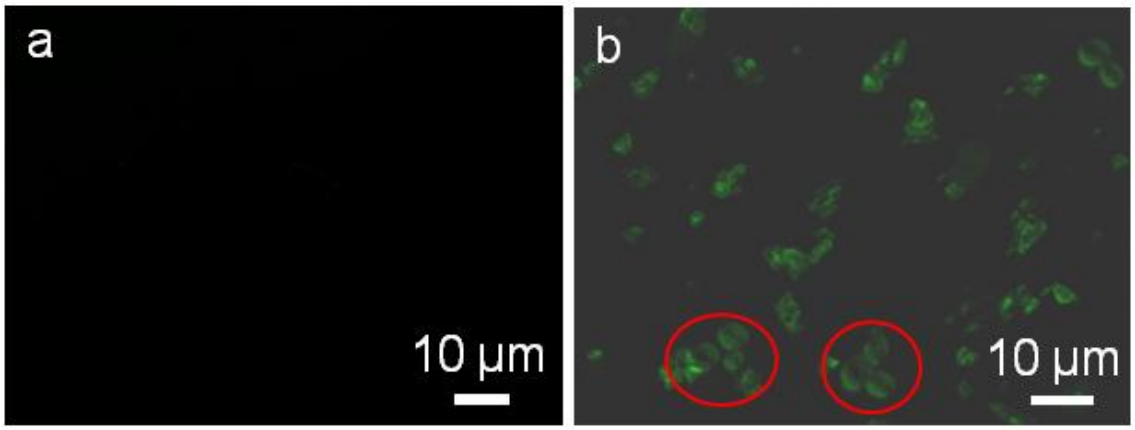

Figure S16. CLSM images of a) PSS but not DNA assembled film after cell transformation, b) yeast cells after transformation in solution.