Electronic Supplementary Material (ESI) for Journal of Materials Chemistry B

Supporting Information

Double Entrapment of VEGF by PCL nanoparticles loaded into Polyelectrolyte multilayer films

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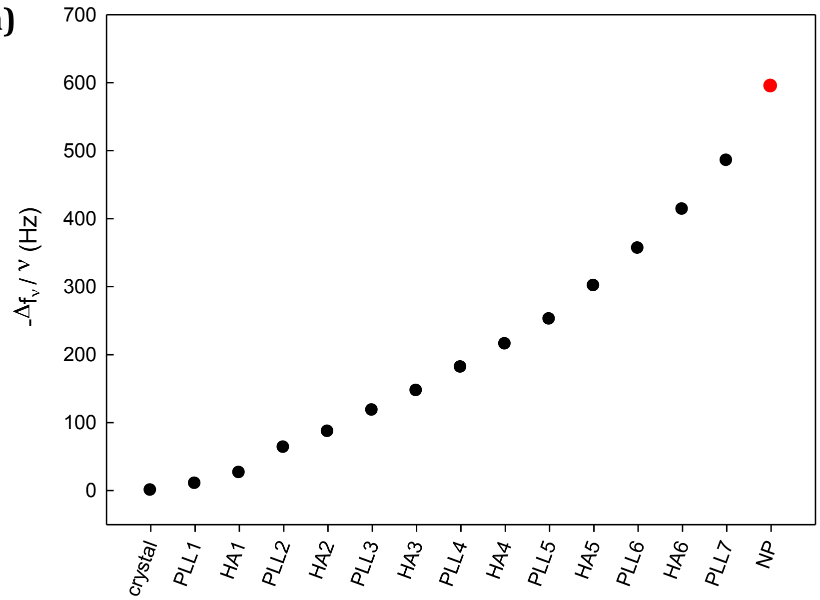
Figure S1.

Build-up of PLL/HA multilayer film (black discs) and nanoparticle deposition (red disc) on a SiO_2 coated crystal followed by QCM (a). The evolution of the normalized frequency $-\Delta f_\nu/\nu$ as a function of the number of layers of polyelectrolytes and nanoparticles deposited was monitored for the third overtone (15 MHz). To characterize the film at a given step, only the frequency at the end of the rinsing steps following the exposure to polycations or polyanions or nanoparticles were shown on the graph. Kinetic of PCL nanoparticles deposited at on a $(PLL/HA)_7$ film was followed over 23 hours (red symbol in graph (a) and graph (b)). 600 µL of the nanoparticles were deposited at 0.02 mg/mL with a flow rate of 250 µL/min.

a)


700
600
500
400
300
200
100
0
-Δf$_\nu$ / ν (Hz)
crystal
PLL1
HA1
PLL2
HA2
PLL3
HA3
PLL4
HA4
PLL5
HA5
PLL6
HA6
PLL7
NP

b)

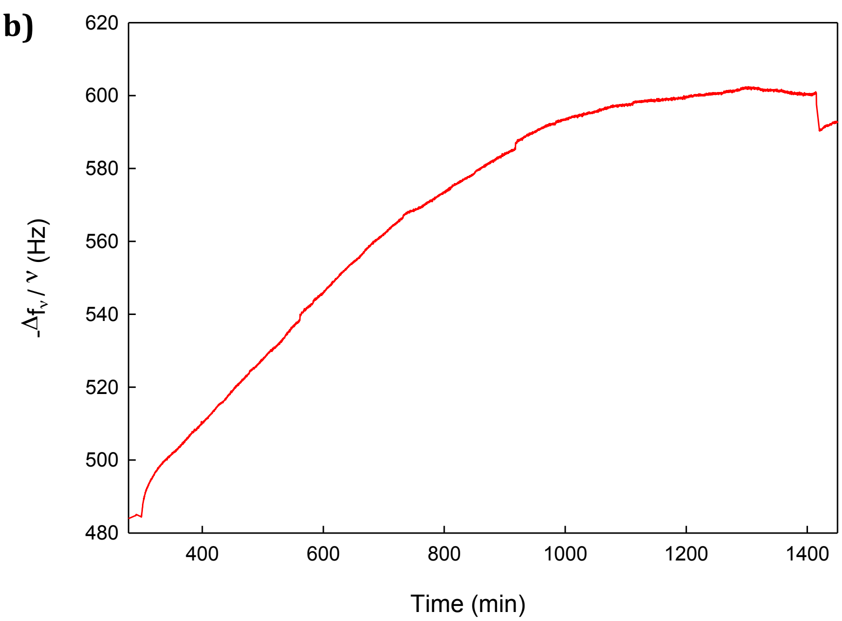

620
600
580
560
540
520
500
480
-Δf$_\nu$ / ν (Hz)
400
600
800
1000
1200
1400
Time (min)

Figure S2a.

Typical force curves were recorded on PLL/HA matrix without nanoparticles (a) and with various nanoparticle loadings (25µL (b), 50 µL (c), 100 µL (d) and 200 µL (e)). White circles correspond to experimental data taken from extended force curves and the red lines correspond to the theoretical fitting with Hertz model. The maximal indentation depth measured for a loading force of 4 nN was decreased successively from 550 nm to 250, 180 and 120 nm when (PLL/HA) matrices were incubated with 25, 100 and 200 µL of nanoparticles respectively. This decrease of the maximal indentation depth can be related to stiffnening of the matrix elasticity, e.g. an increase of the Young modulus.

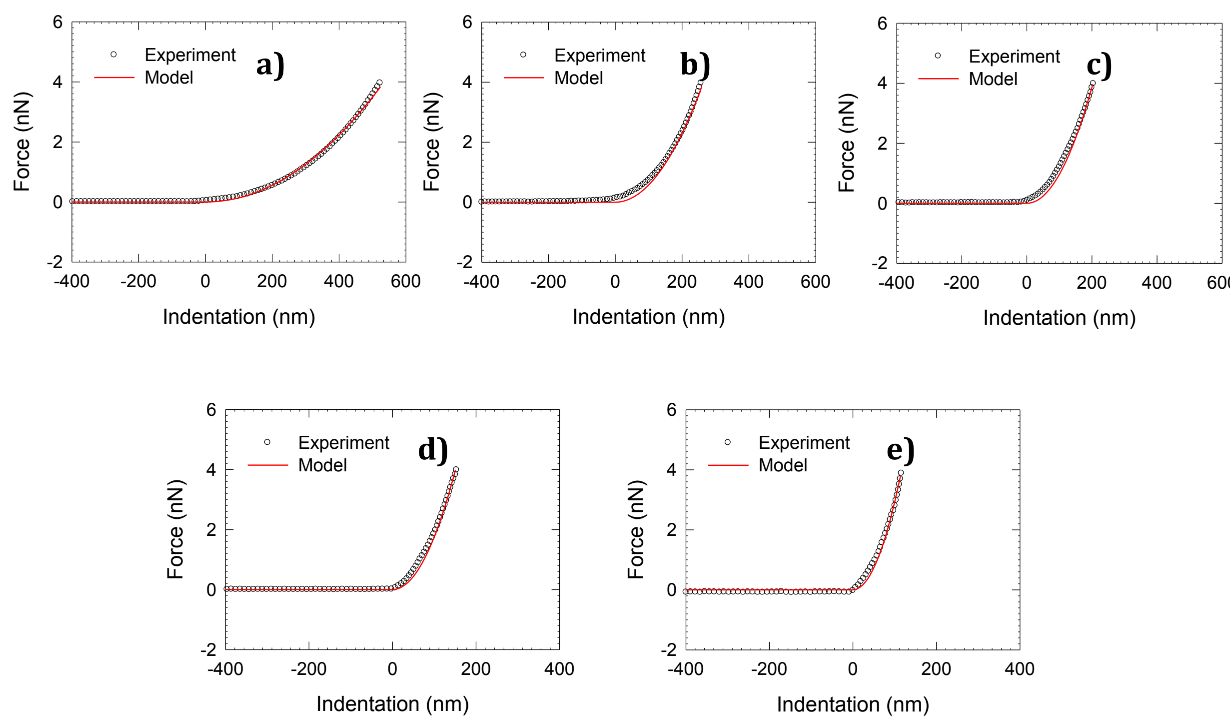


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Figure S2b.

The statistic distribution of Young moduli taken from (PLL/HA) films incubated with increasing nanoparticle concentrations (b, c, d and e) or not (a) was calculated on force-volume images of 1024 force-curves over an area of 40 μm × 40 μm reported in the insets. The corresponding maps represent the stiffness of the films (dark pixels) and the substrate (white pixel) for a bar-scale in the range of 0 to 50, 100 and 500 kPa. These elasticity maps indicated a homogeneous stiffness of the (PLL/HA) matrices without nanoparticles (a) and with films loaded with increasing nanoparticle volumes : 25 μL, 50 μL, 100 μL and 200 μL (b, c, d and e respectively).

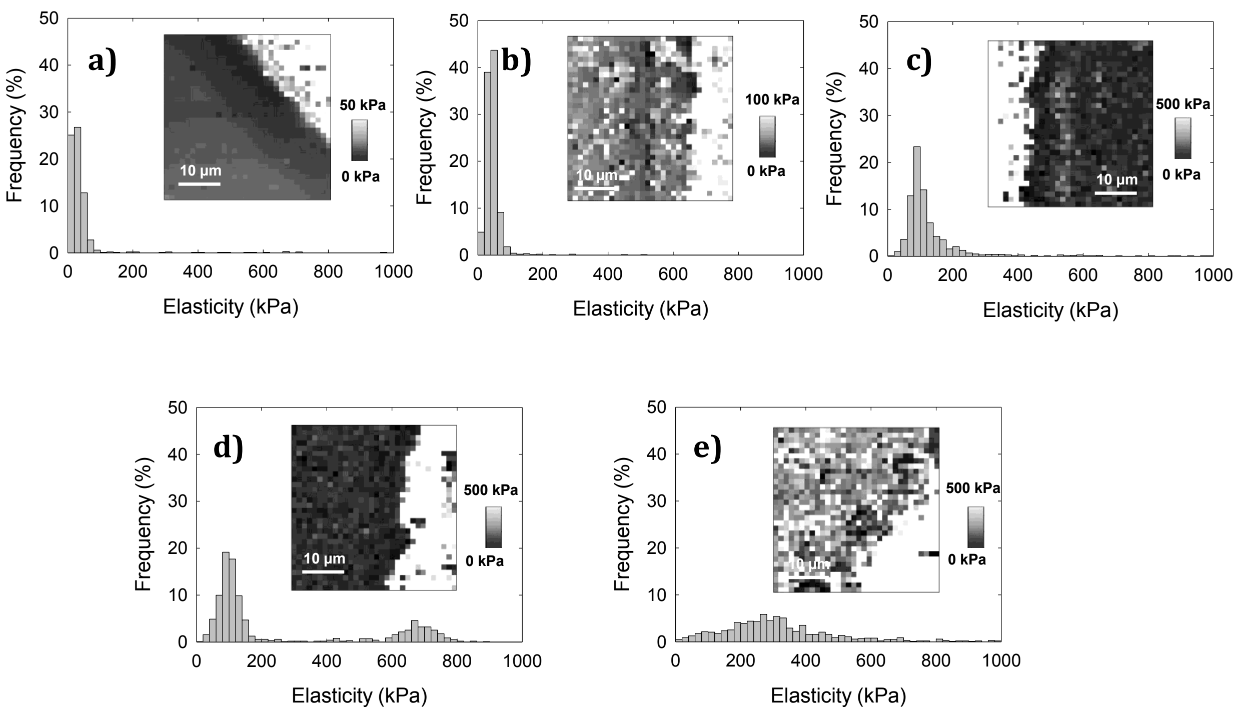

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Figure S2c.

The stiffness of the (PLL/HA) films increases linearly with the deposited volume of PCL nanoparticles.

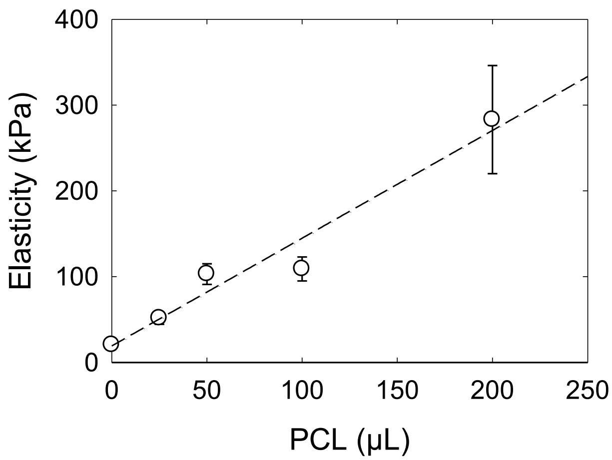

Figure S3.

HUVEC proliferation on the PLL/HA films loaded with empty nanoparticles (without VEGF) at day 1 and day 3. Addition of nanoparticles improved the proliferation due to stiffness increase. However, the NP loaded multilayers could not sustain cell proliferation due to the absence of VEGF. Cell proliferation was determined by a Resazurin based assay with absorbance readings at 600 nm and reference readings at 690 nm. Positive control corresponds to TCPS surfaces.

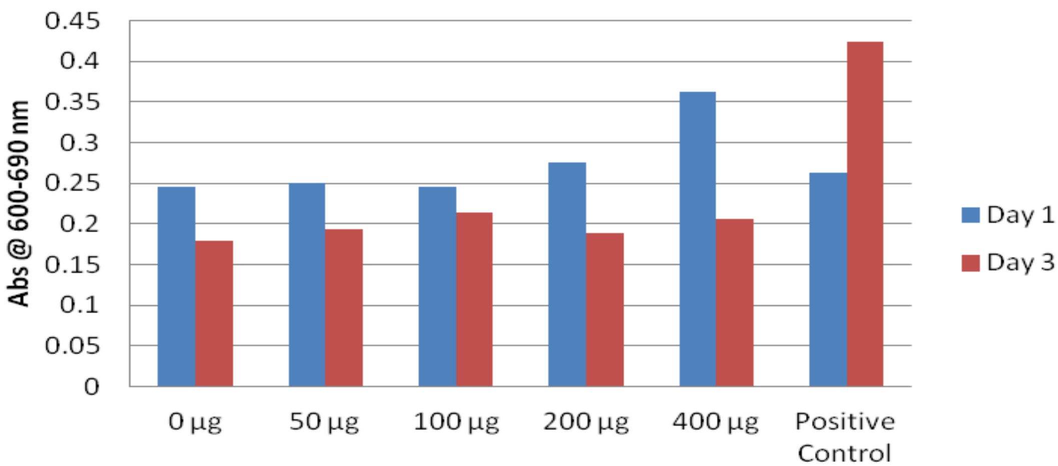

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Figure S4.

Expression of PECAM was checked for HUVEC growing on TCPS around PLL/HA (green labelling). PECAM is an indicator of HUVECs activity. Blue and red stainings correspond respectively to DAPI and TRITC-phalloidin.