Supporting Information for

Nonfouling Polyampholytes from an Ion-pair Comonomer with Biomimetic Adhesive Groups

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Materials. 2-Sulfoethyl methacrylate (>90%) was purchased from Polysciences. 3, 4-Dihydroxyphenyl-L-alanine (DOPA), 2-bromoisobutyric acid, 4,4'-azobis(4-cyanovalerate), dopamine·HCl (≥98.5%) N,N'-dicyclohexyl carbodiimide (DCC), N-hydrosuccinylimide (NHS), copper(I) bromide (99.999%), 2,2'-bipyridine (BPY, 99%), [2-(methacryloyloxy)ethyl]trimethylammonium chloride (75% wt. % solution in water), tetrahydrofuran (THF HPLC grade), Fibrinogen (fraction I from bovine plasma, Fg), Lysozyme (from chicken egg white, Lyz), albumin (from bovine serum, BSA), and phosphate buffer saline (PBS, pH 7.4, 0.15 M, 138 mM NaCl, 2.7 mM KCl) were purchased from Sigma-Aldrich. Tetrabutylammonium fluoride (TBAF, 1 M solution in THF containing ca 5% water), 1,3-diamino-2-hydropropane, silver (I) oxide (>99%), and tert-butyl chlorodimethylsilane (TBDMS, 98%) were purchased from Acros. Water used was purified using a Millipore water purification system with a minimum resistivity of 18.0 MΩ·cm. N, N-Dimethylformamide and dichloromethene was dried

with phosphorous oxide and then distilled. N-succinimidyl 2-bromoisobutyrate (**1**) [1], 3,4-bis(terbutyldimethylsiloxyl)-l-phenylalanine (**2**) [2], Boc-($DOPA_2(TBDMS)_4$-NHS [3]. CBMA monomer [4], and trifluoroacetic acid salt of 2-aminoethyl 2-bromoisobutyrate [5] were prepared following the literature procedures.

2-Bromo-2-methyl-N-1-carboxyl-2-[3, 4- bis (t-butyldimethylsilyloxy)]phenyl-ethyl propionamide (3). N-succinimidyl 2-bromoisobutyrate (0.528g, 2.00mM) was dissolved in dry DMF (2.5mL) and 3,4-bis(terbutyldimethylsiloxyl)-l-phenylalanine(0.85g, 2.00mM) was added at once under N_2, The mixture was stirred on a ice bath, then diisopropylethylamine (DIEA) (350 uL, 2mM) was added via a syringe. The reaction mixture was kept in ice-bath for one hour. The temperature was then raised to room temperature overnight. The mixture was treated with diluted solution of HCl (5 %, 40 mL) and was then extracted with EtOAc (30 mL). The organic layers were combined, washed with DI water (30 mL), and dried with anhydrous $MgSO_4$. The crude product was purified with silica gel with chloroform and 1 % methanol as an eluent. 3,4-bis(*t*-butyldimethylsilyloxy)-N-isobutyryl-l-phenylalanine was obtained as a white foam, (1.09 g, 90%). ^{1}H-NMR ($CDCl_3$), δ: 7.01-7.04 (d, 1H), 6.63-6.80 (m, 3H), 4.73-4.75 (m, 1H), 3.05-3.15(m, 2H), 1.88-1.92 (d, 6H), 0.99(s, 18H), 0.20 (s, 12H).

2-Bromo-2-methyl-N-1-(carbonyloxysuccinimide)-2-[3, 4- bis (t-butyldimethylsilyl oxy)]phenyl-ethyl propionamide (4). Compound **4** was synthesized using the same synthetic procedure as **1**, and the yield is 85 %. ^{1}H-NMR($CDCl_3$), δ: 7.01-7.03 (d, 1H),

6.64-6.79 (m, 3H), 4.72-4.74 (m, 1H), 3.05-3.15(m, 2H), 2.86 (s, 4H), 1.88-1.92 (d, 6H), 0.99(s, 18H), 0.20 (s, 12H).

N,N'-(2-hydroxy-1,3-propanediyl)-bis[2-(N-2-bromo-2-methyl propionamide)–3-(3,4- di(t-butyldimethylsilyloxy))phenyl]propanamide (Catechol$_2$-Br$_2$, initiator 1). **Initiator 1** was synthesized from **4** and 1, 3- diamino isopropyl alcohol and purified with the similar procedures as product **3**, and the yield was 65 % as a yellow foam. ^{1}H NMR ($CDCl_3$), δ: 7.06 (m, 2H), 6.88 (m, 2H), 6.65-6.79 (m, 6H), 4.46-4.51(m, 2H), 3.75-3.78(t, 1), 2.90-3.46 (m, 8H), 1.84-1.93 (d, 12H), 0.99 (s, 36H), 0.19 (s, 24H).

2-[3,4-Di(t-butyldimethylsilyloxy)]phenethylamine (5) The protection of the side-chain catecholic oxygens was achieved by the reaction of dopamine·HCl and t-butyldimethylsilyl (TBDMS) chloride using a method similar to one reported previously.[6, 7] Product **5** was obtained after the reaction (5.19 g, 95%). NMR was recorded using deuterated chloroform as the solvent. ^{1}H NMR (300 MHz, $CDCl_3$), δ : 6.79 (d, 1H), 6.68 (d, 1H), 6.64 (d, 1H), 3.01 (t, 2H), 2.76 (t, 2H), 0.99 (s, 18H), 0.19 (s, 12H).

4,4'-Azobis(4-cyano-N-(2-(3,4-di(tert-butyldimethylsilyloxy))phenyl)-ethyl)-pentan amide) (initiator 2) 4,4'-Azobis(4-cyanopentanoic acid)(V501, Fluka, 0.56 g, 2 mmol) was dissolved in 40 mL 0.1 M MES [2-(N-Morpholino)ethane sulfonic acid] buffer. Excess amount of **5** dissolved in 20 mL THF was added under stir. EDC [1-ethyl-3-(3-dimethylaminopropyl)carbodiimide hydrochloride] (1.92 g, 10 mmol)

dissolved in 20 mL MES buffer was added under stir at room temperature. The solution mixture was stirred overnight at room temperature. Then, the product was extracted with chloroform and applied to a silica gel chromatography (hexane/ethyl acetate (2/1), R_f=0.15). The yield of **initiator 2** is 11 % as a white powder (0.22g). ^{1}H NMR (300 MHz, $CDCl_3$), δ: 6.77 (m, 1H), 6.65 (m, 2H), 3.45 (m, 2H), 2.70 (t, 2H), 2.38 (m, 2H), 1.72 (s, 3H), 1.59 (t, 2H), 1.00 (s, 18H), 0.21 (s, 12H).

2-Methacryloyloxyethyltrimethylammonium 2-methacryloyloxyethanesulfonate (METMA·MES). The ion-pair monomer was synthesized by a similar procedure published before.[8] To a light-shielded suspension of silver (I) oxide (10.79g, 46.6 mmol) in 100 mL water was added slowly with stirring 2-sulfoethyl methacrylate (9.04g, 46.6 mmol) in 10 mL water. The reaction was then continued for another 5 h at room temperature. After filtration to remove the remaining silver oxide, the filtrate was titrated by 5% wt. aqueous solution of [2-(methacryloyloxy)ethyl]trimethylammonium chloride while stirring at room temperature. The white precipitate of silver chloride formed immediately and the mixture was stirred adequately during the titration. When there is no new precipitate generated in the solution, the precipitate was filtered and the filtrate was lyophilized (15.3 g, 90%).

^{1}H NMR ($CDCl_3$), δ: 1.95 (s, 6H), 3.18 (t, 2H), 3.42 (s, 9H), 4.00 (t, 2H), 4.54 (t, 2H), 4.64 (t, 2H), 5.56 (m, 1H), 5.66 (m, 1H), 6.13 (m, 2H).

Synthesis of polymer I. Initiator 1 (26mg, 0.022 mM), BPY (20mg, 0.13 mM), and CuBr (6.50 mg, 0.045 mM) were placed into a three-necked flask, and the system was

degassed three times and filled with N_2, then 2mL DMF (degassed) was added under N_2. The mixture was stirred for 20 mins at 60 ^oC. Ion pair monomer (0.44g, 1.20 mM), dissolved in DMF (degassed, 3mL) was added into the reaction system, the polymerization continued for 24 hrs at 60 ^oC. The resulting polymer, precipitated by acetone, was collected by filtration. After dissolved in H_2O, the polymer solution was dialyzed for 5 days with DI water. **Polymer I** (white powder, 0.31 g, 70 %, Mn 19143, PDI 1.5) was obtained after lyophilization.

Synthesis of polymer II. Initiator 2 (27.8mg, 0.028 mM) and ion pair monomer (0.5 g, 1.37 mM) were placed into three-necked flask, and the system was degassed three times and filled with N_2, then 5mL DMF (degassed) was added under N_2. The mixture was stirred for 10 mins, then heated to 60 ^oC. The polymerization continued for 24 hrs at 60 ^oC. The resulting polymer, precipitated by acetone, was collected by filtration. After dissolved in H_2O, the polymer solution was dialyzed for 5 days with DI water. **Polymer II** (white powder, 0.33 g, 66 %, Mn 28276, PDI 1.8) was obtained after lyophilization.

Polymer characterization. Molecular weights of the polymers were determined using aqueous gel permeation chromatography (GPC) (Waters 2695 Separations Module) fitted with a Waters 2414 refractive index detector and two Waters ultrahydrogel columns in series (ultrahydrogel 250 and ultrahydrogel 1000, 7.8 mm×300 mm). The buffer solution (0.1 M K_2HPO_4-KH_2PO_4 buffer, pH 7.4) was used as the eluent with a flow rate of 0.7 mL/min at 50 ^oC. All samples were filtered through 0.2 micron PTFE filters prior

to injection. The system was calibrated with narrow molecular weight polyethylene oxide standards.

Polymer deprotection. Before surface adhesion, the TBDMS groups of protected **polymer I** and **polymer II** were removed using TBAF in order to achieve complete deprotection. A solution with 1.0 mM TBDMS protected polymer and 10 mM TBAF in THF was stirred overnight. The suspension was centrifuged and the supernatant was removed. The remaining white powder was washed three times with THF and dried under reduced pressure.

Surface modification. 6 mg deprotected polymer was dissolved in 2mL DI water (pH=3) in a 20 mL glass tube, and 1 mL THF was added dropwise into this tube. The solution was then transferred to a Teflon cell. Cleaned Au chips prepared as described before [7], were placed into the cell and submerged for 24 hrs. The chip was washed with DI water and dried with airflow before use.

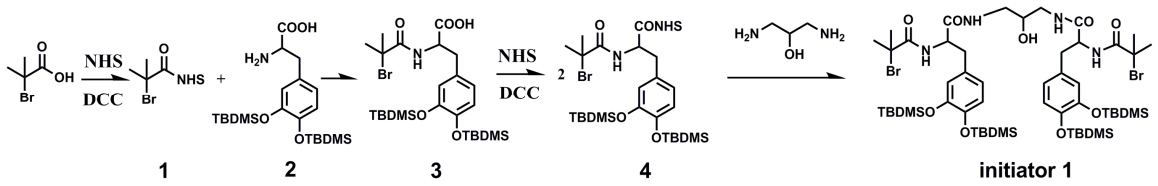
Film thickness by ellipsometer. Alpha-SE spectroscopic ellipsometer (J.A. Woollam Co., Inc.) was used to measure film thickness.

Surface characterization by ATR-FTIR. Attenuated total reflectance Fourier transform infrared (ATR-FTIR) spectra of the coated surfaces were acquired with a Bruker tensor 27 instrument (Billerica, MA), a single reflection Ge-ATR accessory with a 65 ° incident angle. The spectra were collected with 64 scans at 4 cm^{-1} resolution using a RT-DLaTGS detector. The instrument was controlled by OPUS v5.0 software.

Composition by Electron Spectroscopy for Chemical Analysis (ESCA). Samples coated with **polymer I** and **polymer II** were prepared as described above. The samples were rinsed extensively with 18.2 MΩ cm water, dried with filtered air, and placed in a desiccator overnight before analysis. ESCA spectra were taken on a Surface Science Instruments S-probe spectrometer with monochromatized Al Kα X-rays. The spot size for these acquisitions was ~800 μm. The pass energy for the survey spectra was 150 eV. Detailed scans were completed with identical pass energy for both N and S peaks to accurately quantify any small amounts of those elements. The ESCA 2000 A Analysis software v. 102.04 (Service Physics, Bend, OR) was used for peak integration.[9, 10]

Protein Adsorption by SPR. Protein adsorption was measured with a custom-built four-channel SPR sensor (Institute of Radio Engineering and Electronics, Academy of Sciences, Prague, Czech Republic) based on the Kretschmann geometry of the attenuated total reflection method and wavelength modulation. [11] Coated chips were rinsed extensively with 18.2 MΩ cm H_2O, dried with filtered air, and then mounted to a coupling prism using refractive index matching fluid (Cargille, Cedar Grove, NJ). A baseline signal was established by flowing PBS at a rate of 50 μL/min through the sensor for 10 min. Following this, fresh 1 mg/mL protein solutions of Fg, Lyz, and BSA were flowed through independent channels for 10 min to measure the adsorption of these proteins to the polymer brush-coated surfaces. To remove unbound protein molecules and to reestablish the baseline, PBS buffer was flowed for an additional 10 min. Protein adsorption was quantified by measuring the change in wavelength in the buffer baseline

before and after the injection of protein solutions. The shift was converted to an adsorbed amount. For the SPR sensor used in this study, a 1 nm shift in wavelength starting at 750 nm represents a surface coverage of ~15 ng/cm^2 of adsorbed protein.



Scheme S1. Reaction steps for the synthesis of **initiator 1**.

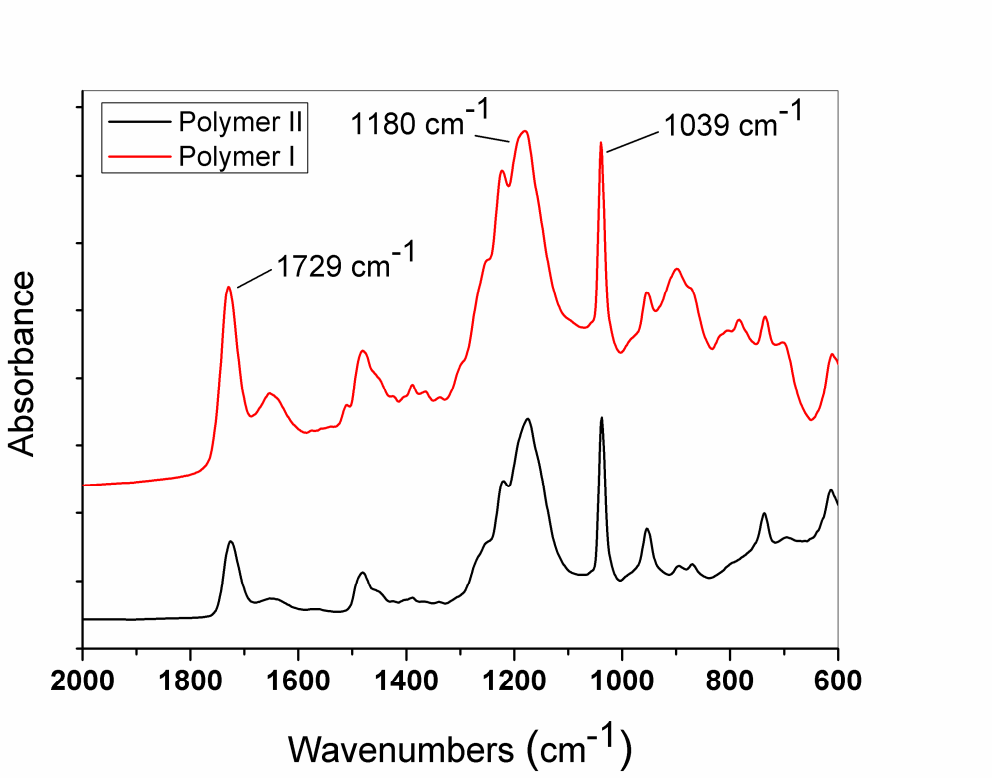


Figure S1. Typical ATR-FTIR spectra of the surfaces modified by **polymer I** and **polymer II**. Bare gold was used as the background.

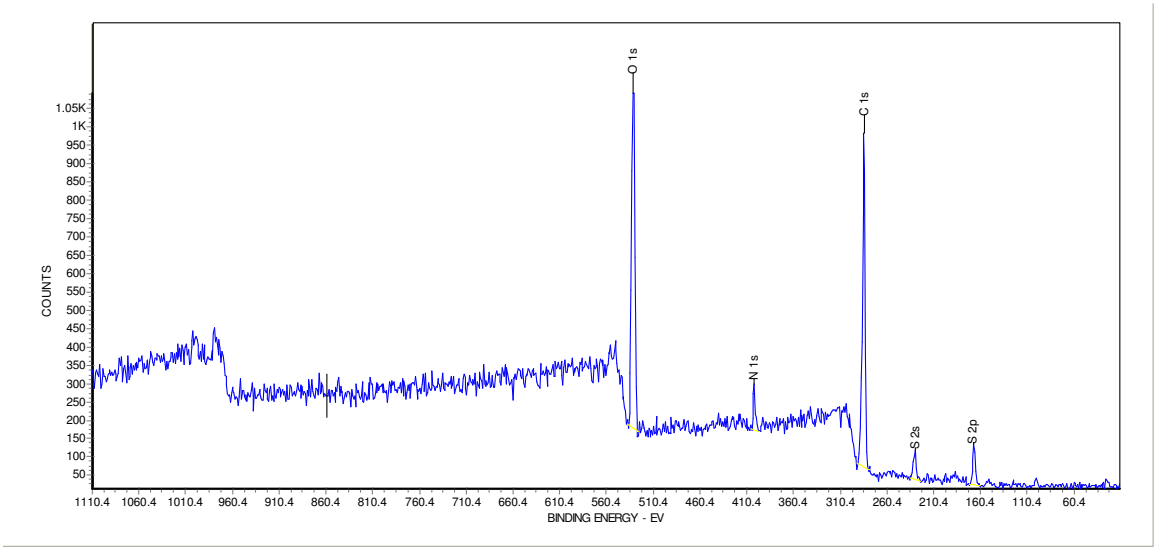


Figure S2. Representative ESCA survey scan for the surface modified by **polymer I**.

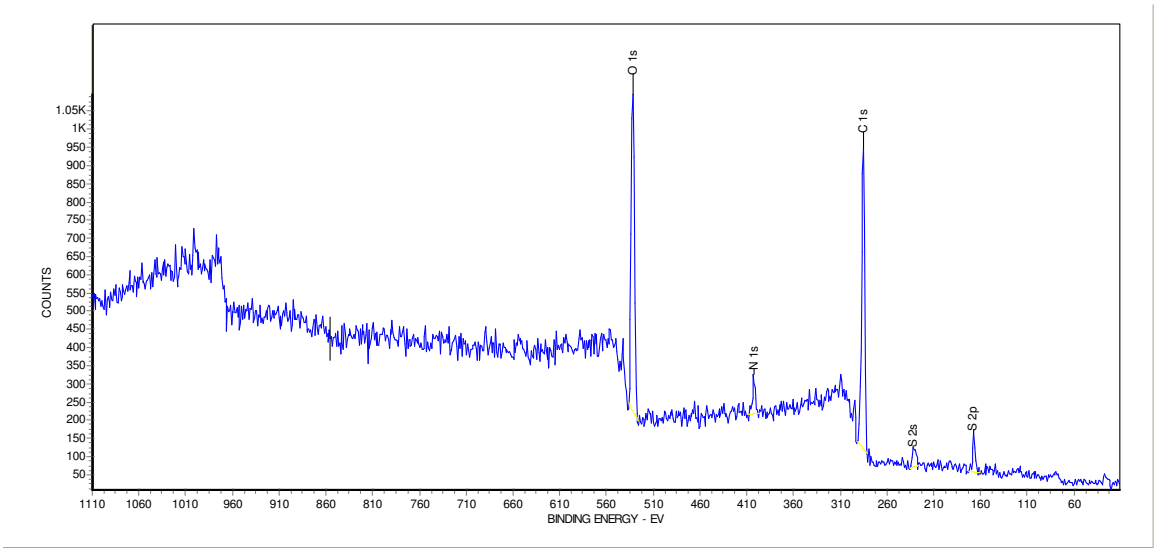


Figure S3. Representative ESCA survey scan for the surface modified by **polymer II**.

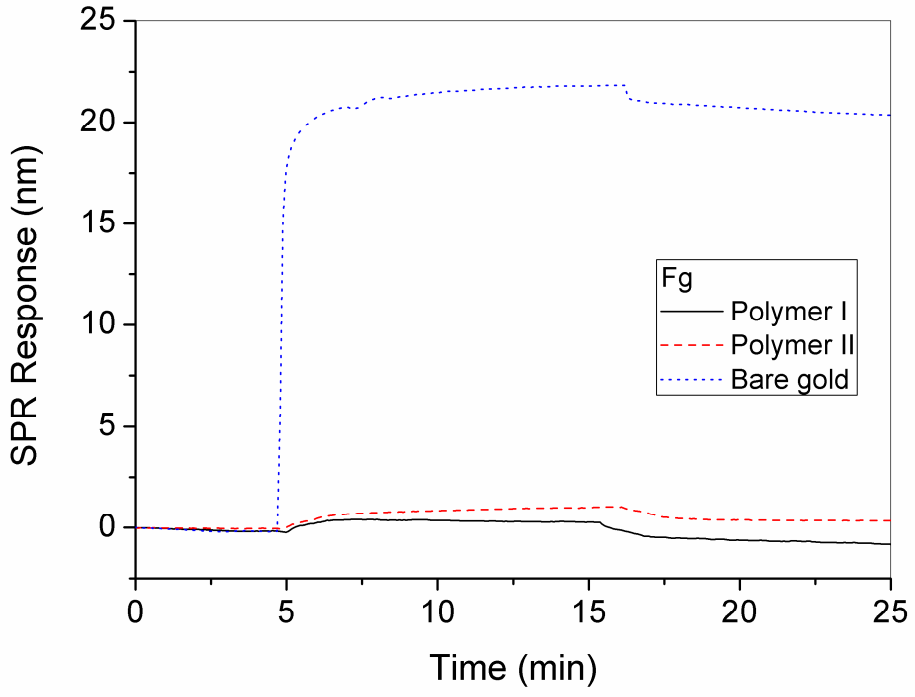


Figure S4. Representative SPR sensorgrams showing typical fibrinogen adsorption on the surfaces modified by **polymer I** and **polymer II** and a bare gold surface.

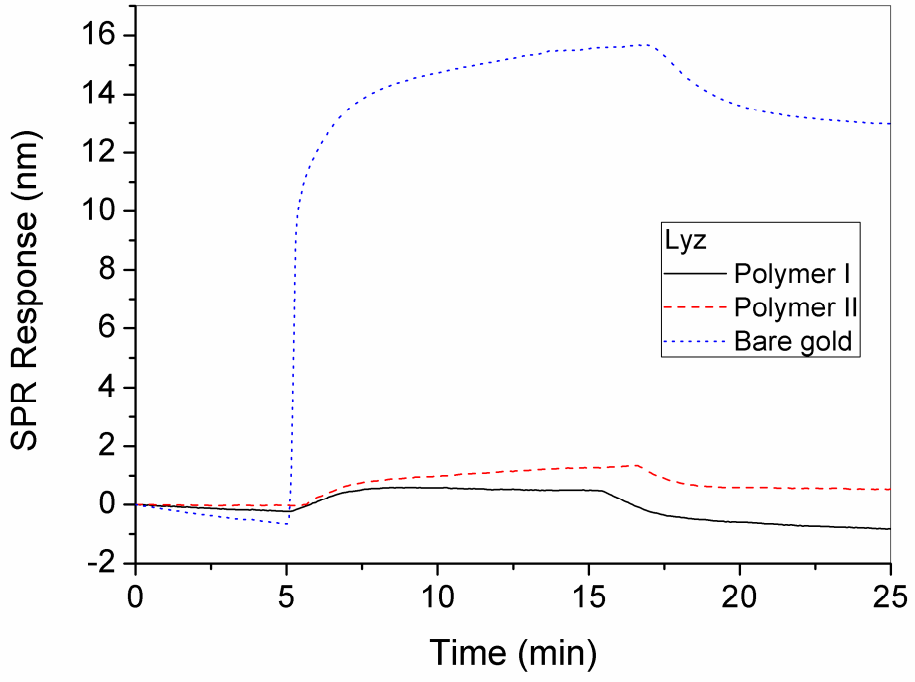


Figure S5. Representative SPR sensorgrams showing typical lysozyme adsorption behavior on the surfaces modified by **polymer I** and **polymer II** and a bare gold surface.

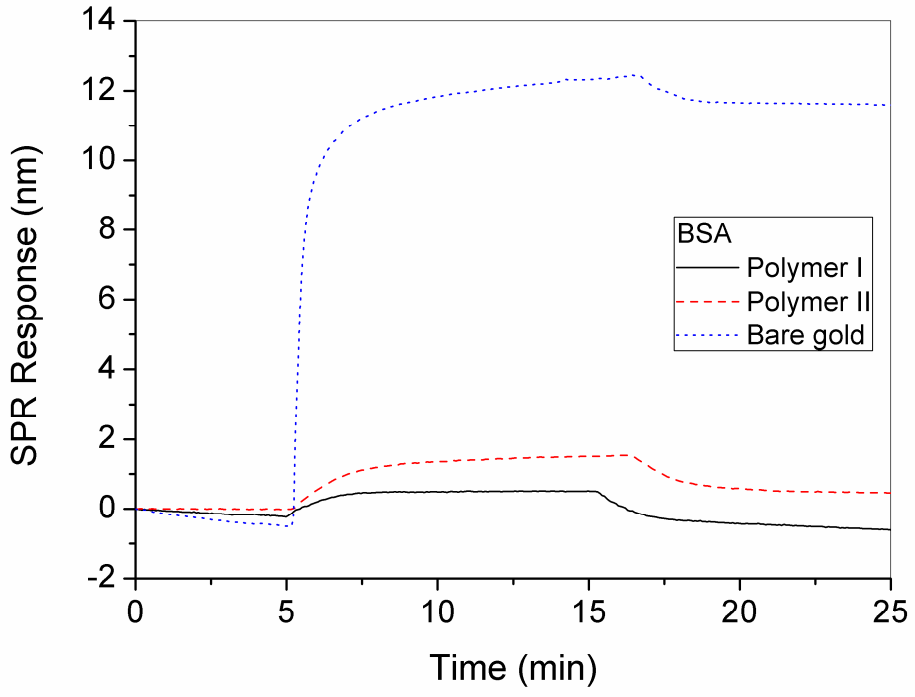


Figure S6. Representative SPR sensorgrams showing typical bovine serum albumin adsorption on the surfaces modified by **polymer I** and **polymer II** and a bare gold surface.

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