Supporting Information

Reversible pH Responsive Bovine Serum Albumin Hydrogel Sponge Nanolayer

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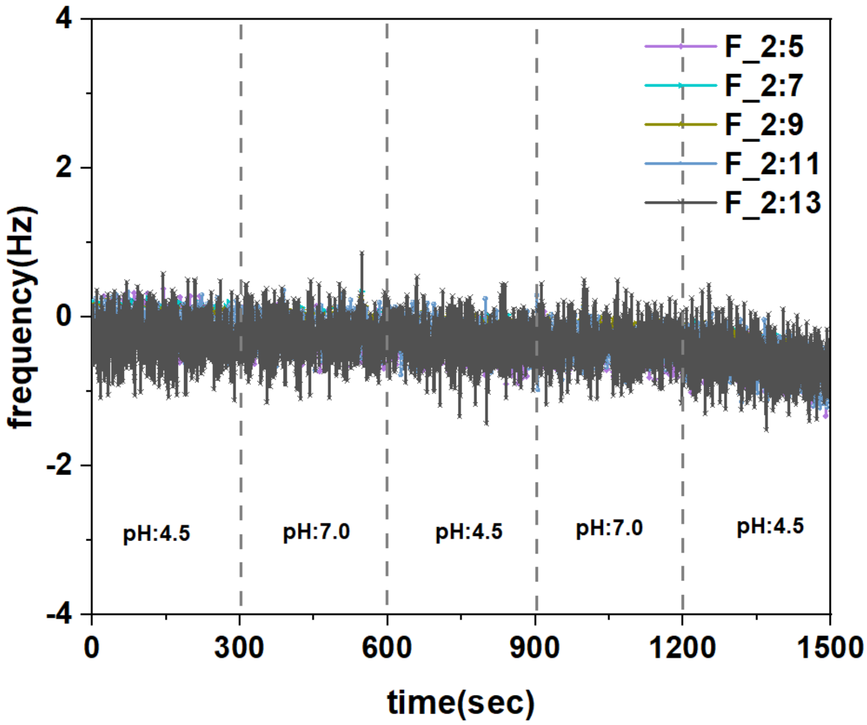
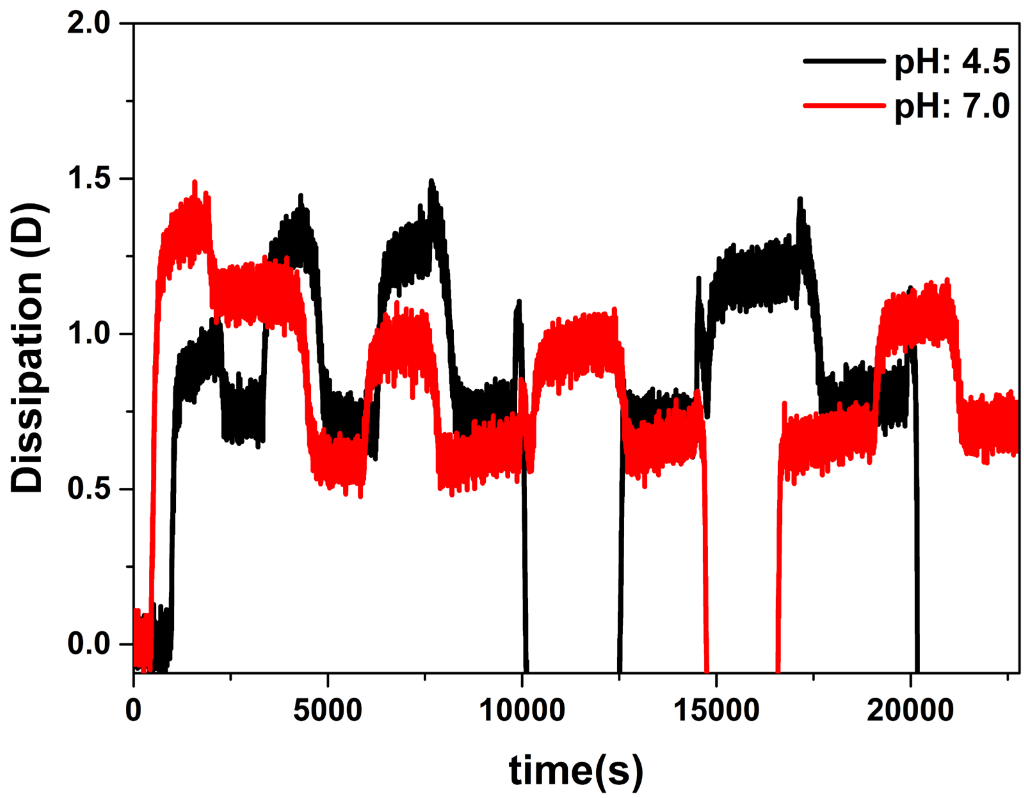
S1: Bare gold coated quartz sensor rinsed with the saline at different pH of 4.5 and 7.0.



S2: Dissipation of BSA adsorbed at pH 4.5 and 7.0 followed by saline rinse cycle at different pH.



S3: Calculation on BSA sorption at the gold interface

Calculated number of BSA molecules and adsorbed water per BSA molecule

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BSA in 0.9% NaCl saline solution was made at a concentration of 1 mg/mL. The mass of a single BSA molecule is 1.1×10^{-16} mg (dry mass) and that of a single water molecule is 2.99×10^{-20} mg.

The number of BSA molecules from the wet mass of BSA (6.4 mg/m^2) at the sensor surface is calculated at pH 4.5 as:

$6.4/1.1 \times 10^{-16} = 5.82 \times 10^{16}$ BSA molecules/m^2

The number of adsorbed water molecules is evaluated from the difference of the mass with and without water molecules (1.0 mg/m^2):

$1.0/2.99 \times 10^{-20} = 3.3 \times 10^{19}$ adsorbed water molecules/m^2

This provides the number of water molecules attached/trapped per BSA molecule and is calculated as:

Number of water molecules/BSA = $3.3 \times 10^{19} / 5.8 \times 10^{16}$ = **569 or 570**

Similarly, the number of BSA molecules at the sensor surface is calculated at pH 7.0 as:

$5.6/1.1 \times 10^{-16} = 5.1 \times 10^{16}$ BSA molecules/m^2

Number of Water molecules = $0.7/2.99 \times 10^{-20} = 2.3 \times 10^{19}$ adsorbed water molecules

Number of water molecules/BSA = $2.3 \times 10^{19} / 5.1 \times 10^{16}$ = **450**

Relative number of BSA molecules adsorbed (dry mass) at the sensor

BSA molecules have dimensions of 14 nm x 4 nm x 4 nm and modelling of the QCM-D data gives an average thickness of 5.5 ± 0.5 nm. Therefore, it is likely that the BSA molecule retains in a lying conformation at the gold interface and forms a rigid monolayer (5 nm thick). Assuming that BSA molecules in the lying position cover the complete surface of the sensor, then the number of BSA molecules adsorbed is:

Surface area of sensor of 1 cm in diameter = $\pi \times 0.5^2 = 0.8$ cm^2

Surface area of a BSA molecule in a flay lying conformation = 14 nm x 4 nm = 56×10^{-14} cm^2

Therefore, the number of BSA molecule covering the complete surface of sensor is:

$0.8/56 \times 10^{-14}$ = **1.4×10^{12} molecules**

Or BSA molecules/m^2 = $1.4 \times 10^{12}/0.8 \times 10^{-4} = 1.75 \times 10^{16}$ molecules/m^2

The weight of a BSA molecules determined as:

BSA molecular weight: 66400 g/mol

1 mole of BSA = 66400 g

6.023×10^{23} molecules of BSA = 66400 g

1 molecules of BSA = 1.1×10^{-19} g or 1.1×10^{-16} mg

The total mass of adsorbed BSA on sensor surface (1 cm in diameter) is:

1.1×10^{-19} g x 1.4×10^{12} molecules = 1.5×10^{-7} g OR **0.15 µg**

The BSA mass adsorb per unit area of sensor:

0.15×10^{-3} mg / 0.8×10^{-4} m^2 = **1.9 mg/m^2**