Supplementary Information for Electronic Conductance Resonance in non-Redox Proteins

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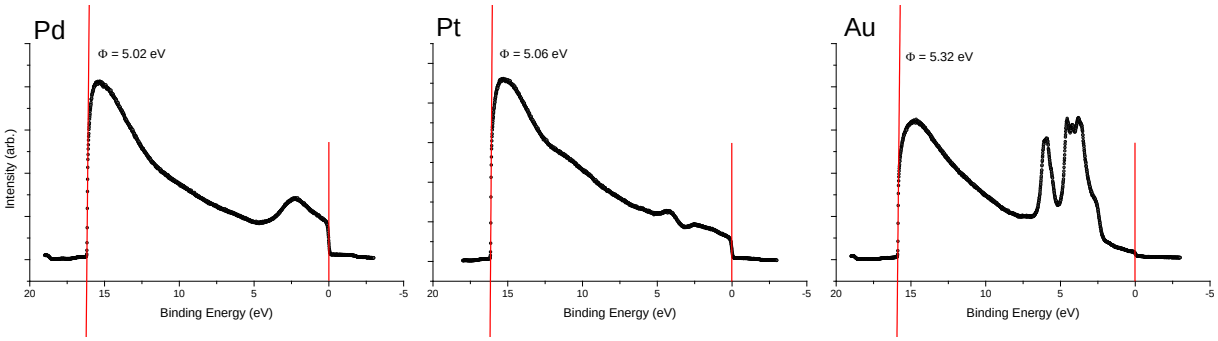

Figure S1: UPS spectra for the three metals after *In-Situ* hydrogen plasma cleaning. The secondary electron emission cutoff was determined using the linear fit method. The work function is the difference in energy between the photon energy and this secondary electron emission cutoff. The work function is a measure of the difference between the vacuum energy level and the Fermi Energy.

$$\Phi = \hbar\omega - x_0 \qquad \text{where,} \qquad \hbar\omega = 21.2 \text{ eV}$$

Work Functions of Various Metals (eV)			
	Palladium	Platinum	Gold
As Received	4.57	4.62	4.85
Plasma Cleaned	5.02	5.06	5.32

Table S1: Work functions of the metals before and after plasma cleaning.

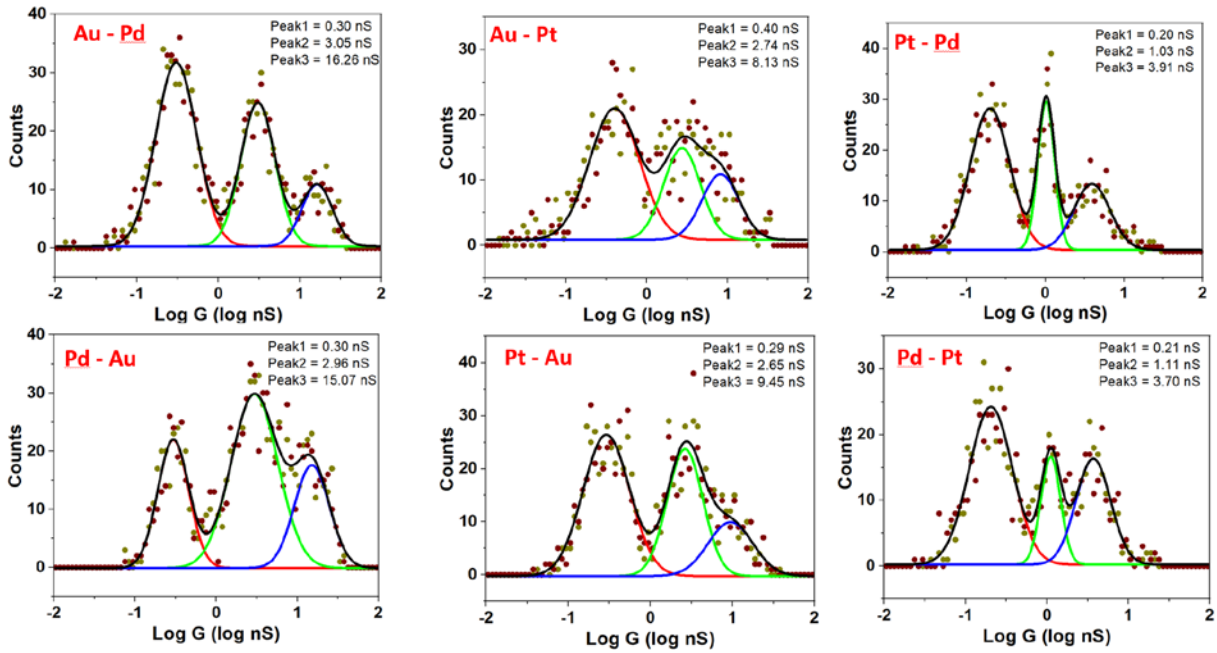

Figure S2: Conductance distributions for the streptavidin-biotin system (gap = 2.5 nm) for the tip (first metal listed) - substrate (second metal listed) combinations.

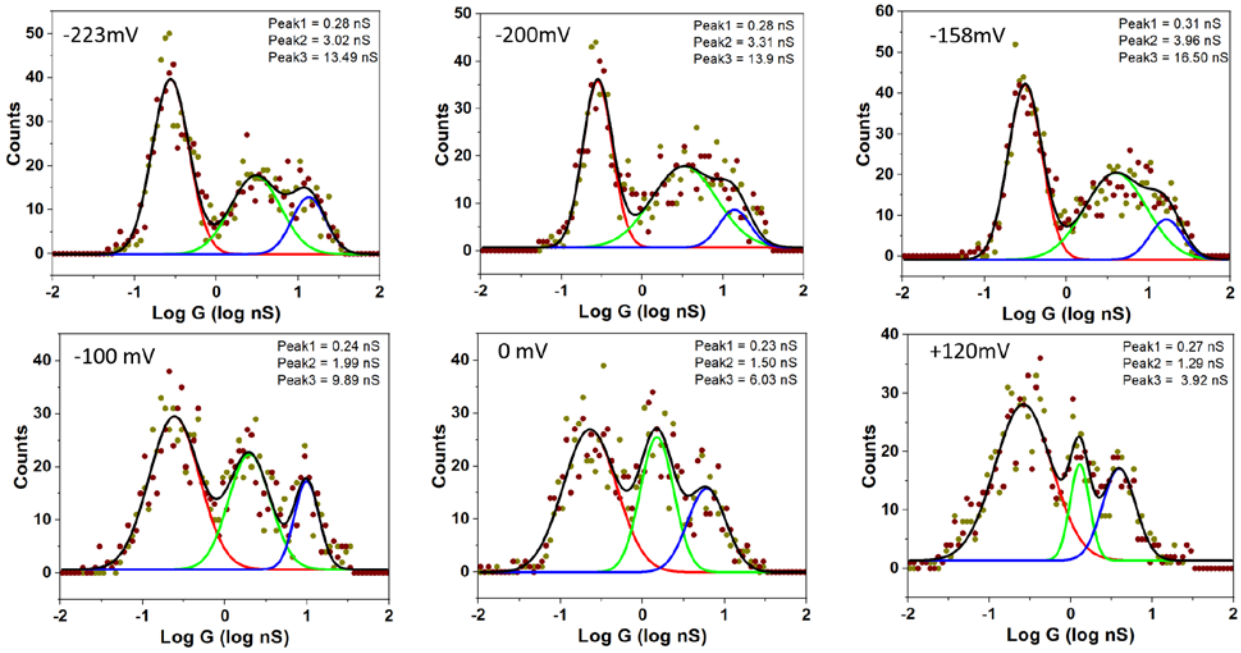

Figure S3: Conductance distributions for the streptavidin-biotin system (gap = 2.5 nm) for the substrate potentials as listed vs. a 10 mM salt-bridged Ag/AgCl reference with Pd electrodes. These potentials are converted to NHE by adding 380 mV.

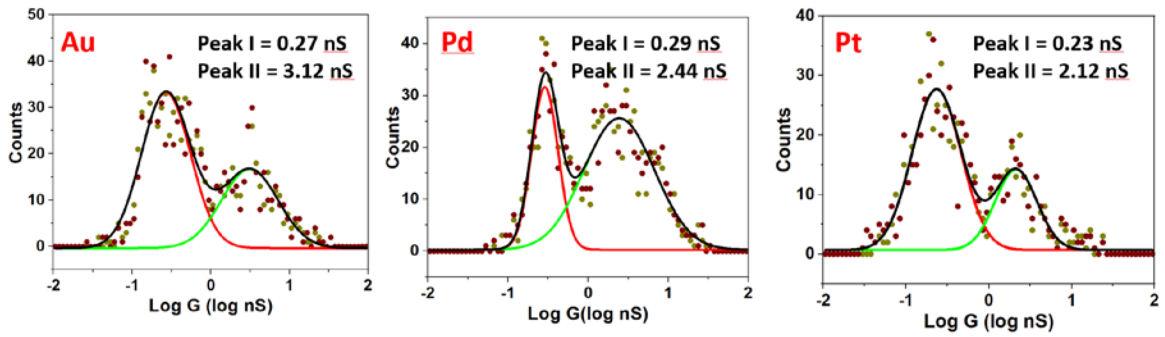

Figure S4: Conductance distributions for the DNP-anti DNP IgG system (gap=4.5 nm) for the three metals shown.

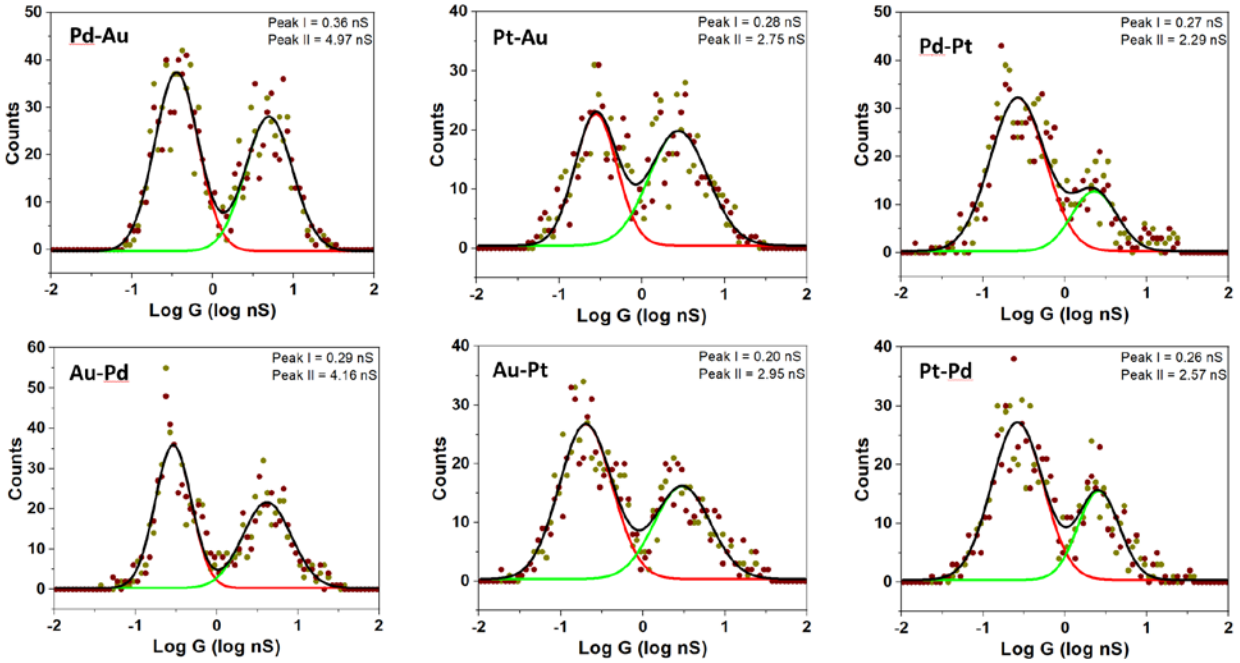

Figure S5: Conductance distributions for the DNP-anti DNP IgG system (gap=4.5 nm) for the tip (first metal listed) - substrate (second metal listed) combinations.

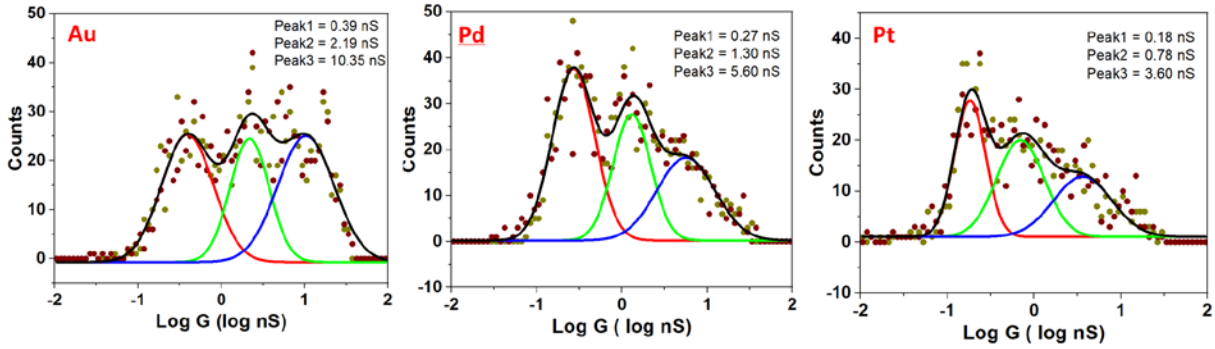

Figure S6: Conductance distributions for the biotin-SA-Φ29 system (gap=4.5 nm) for the three metals shown.

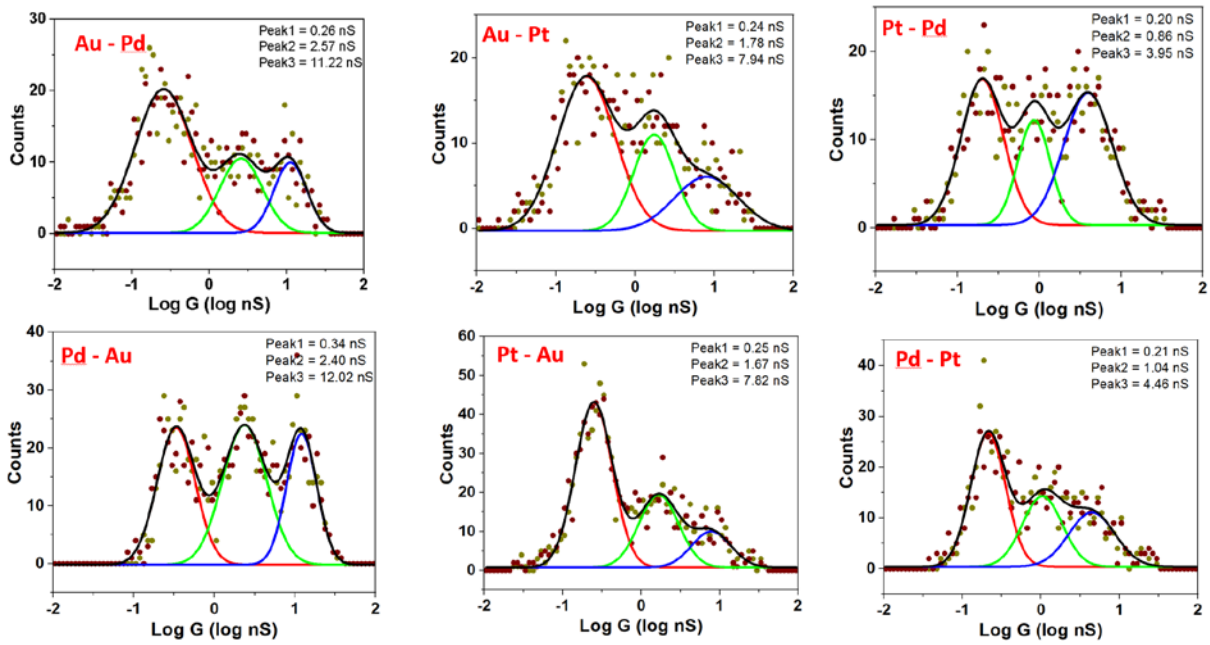

Figure S7: Conductance distributions for the biotin-SA-Φ29 system (gap=4.5 nm) for the tip (first metal listed) - substrate (second metal listed) combinations.

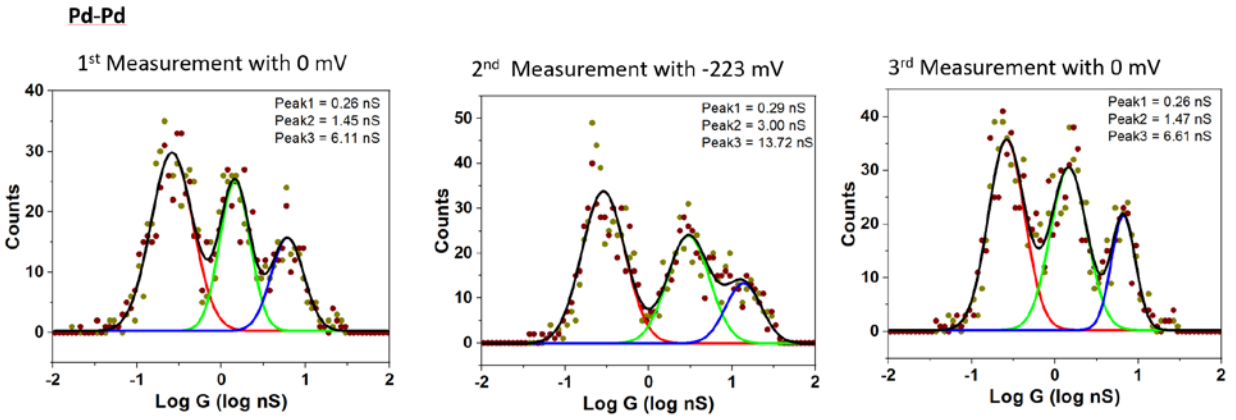

Figure S8. Reversibility of the conductance distributions over the range of surface potential measured (values shown are vs. the 10 mM salt-bridged Ag/AgCl electrode). Fitting paramters are listed in Table S6.

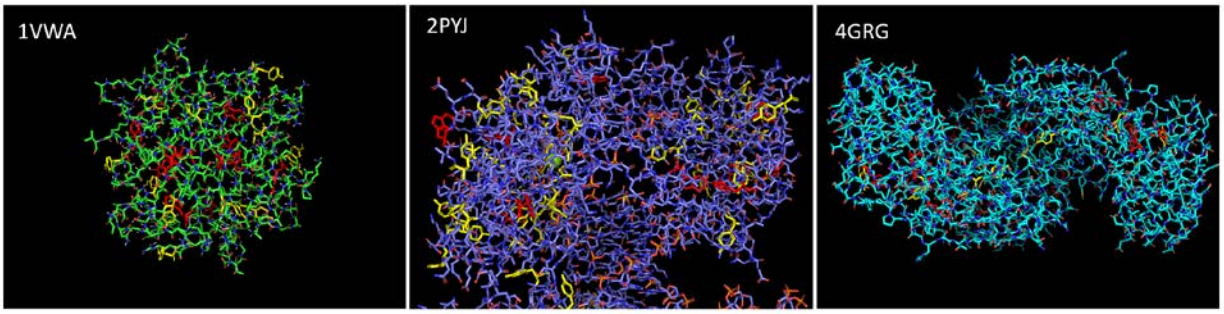

Figure S9: Tyrosines (yellow) and tryptophans (red) in streptavidin (1VWA), Φ29 polymerase (2PYJ) and an IgE molecule (4GRG) where the codes are PDB IDs.

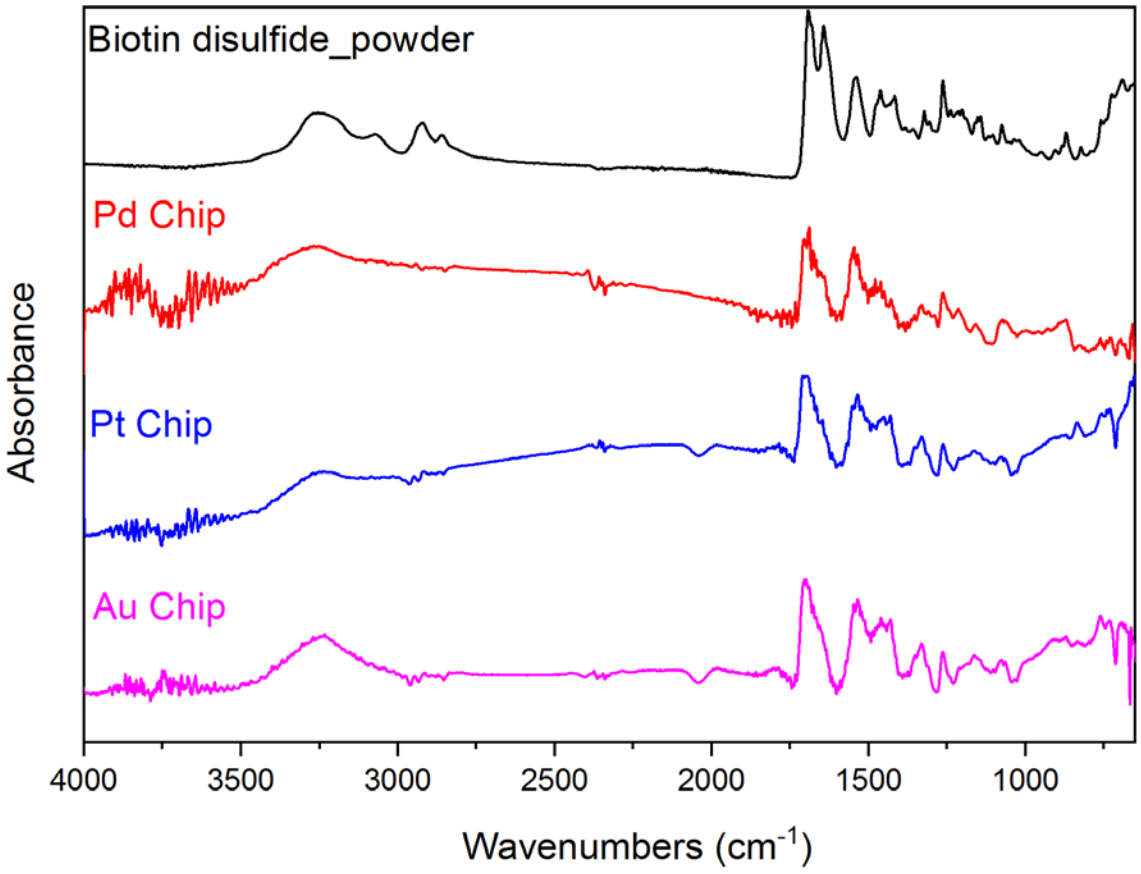

Figure S10: FTIR scans from Pd, Pt and Au surfaces modified with thiolated biotin. The top recording is the bulk (disulfide) powder.

Materials (Tip-Sub)	Peak I			Peak II			Peak III		
	Position (nS)	Height (Counts)	Half Width (Log G)	Position (nS)	Height (Counts)	Width (Log G)	Position (nS)	Height (Counts)	Half Width (Log G)
Au - Au	0.41±0.02	26.89±1.63	0.42±0.03	2.88±0.11	32.89±1.60	0.58±0.04	13.45±0.62	18.42±2.30	0.24±0.04
Pd - Pd	0.26±0.01	52.75±1.83	0.60±0.04	1.50±0.08	40.99±2.93	0.41±0.05	6.80±0.63	31.76±1.92	0.59±0.08
Pt - Pt	0.17±0.01	26.46±0.96	0.56±0.04	0.91±0.07	16.04±0.99	0.49±0.11	3.63±0.44	9.80±1.51	0.38±0.08
Au - Pd	0.30±0.01	31.47±0.83	0.50±0.02	3.05±0.07	24.59±0.93	0.42±0.02	16.26±0.75	10.59±0.94	0.38±0.05
Au - Pt	0.40±0.02	20.13±0.92	0.62±0.06	2.74±0.55	14.01±5.05	0.46±0.18	8.13±1.27	10.02±5.52	0.46±0.20
Pt - Pd	0.20±0.01	27.82±0.85	0.50±0.02	1.03±0.01	29.16±1.24	0.22±0.01	3.91±0.17	12.95±0.90	0.46±0.04
Pd - Au	0.30±0.01	22.01±1.04	0.38±0.02	2.96±0.14	29.90±0.92	0.58±0.04	15.07±0.70	17.68±1.15	0.43±0.04
Pt - Au	0.29±0.01	26.67±1.10	0.57±0.03	2.65±0.12	23.95±1.42	0.43±0.04	9.45±1.41	10.16±1.61	0.55±0.07
Pd - Pt	0.20±0.01	23.99±0.81	0.53±0.02	1.11±0.03	16.38±1.16	0.24±0.03	3.70±0.14	16.11±0.90	0.43±0.04

Table S2. Conductance measurement of streptavidin with different materials as the electrodes

Materials (Tip-Sub)	Peak I			Peak II			Peak III		
	Position (nS)	Height (Counts)	Half Width (Log G)	Position (nS)	Height (Counts)	Width (Log G)	Position (nS)	Height (Counts)	Half Width (Log G)
Au - Au	0.39±0.03	26.04±1.30	0.62±0.07	2.19±0.15	25.16±1.84	0.47±0.06	10.35±0.72	25.74±1.56	0.68±0.08
Pd - Pd	0.27±0.01	37.35±1.24	0.50±0.02	1.30±0.09	27.46±1.52	0.44±0.03	5.60±0.52	18.04±1.23	0.68±0.06
Pt - Pt	0.18±0.004	26.71±1.26	0.36±0.02	0.78±0.05	18.95±1.12	0.55±0.07	3.60±0.33	11.84±0.99	0.67±0
Au - Pd	0.26±0.01	20.12±0.77	0.74±0.04	2.57±0.30	10.43±0.88	0.54±0.12	11.22±0.76	9.85±0.94	0.43±0.06
Au - Pt	0.24±0.02	18.08±0.75	0.73±0.06	1.78±0.16	11.27±1.36	0.52±0.09	7.94±1.85	6.34±1.12	0.81±0.15
Pt - Pd	0.20±0.01	16.57±0.76	0.52±0.05	0.86±0.07	11.91±1.30	0.40±0.08	3.95±0.32	15.02±0.72	0.60±0.06
Pd - Au	0.34±0.01	23.68±1.04	0.47±0.03	2.4±0.11	24.12±0.91	0.55±0.08	12.02±0.33	22.62±1.14	0.38±0.03
Pt - Au	0.25±0.01	42.33±1.06	0.47±0.02	1.67±0.09	18.62±1.09	0.51±0.06	7.82±0.92	9.27±1.28	0.50±0.12
Pd - Pt	0.21±0.01	26.38±1.01	0.44±0.03	1.04±0.08	13.88±0.99	0.51±0.10	4.46±0.56	10.67±1.44	0.59±0.05

Table S3. Conductance measurement of phi29 with different materials as the electrodes

Materials (Tip-Sub)	Peak I			Peak II		
	Position (nS)	Height (Counts)	Half Width (Log G)	Position (nS)	Height (Counts)	Half Width (Log G)
Au - Au	0.27±0.01	33.64±1.18	0.63±0.03	3.12±0.21	17.06±1.13	0.72±0.08

Pd - Pd	0.29±0.01	31.34±1.29	0.33±0.02	2.44±0.1	25.35±0.83	0.88±0.04
Pt - Pt	0.23±0.01	27.03±0.88	0.59±0.03	2.12±0.1	13.52±0.93	0.51±0.05
Au - Pd	0.29±0.01	35.49±1.31	0.45±0.02	4.16±0.17	21.31±1.16	0.60±0.04
Au - Pt	0.20±0.01	26.33±0.92	0.65±0.03	2.95±0.16	15.79±0.90	0.68±0.05
Pt - Pd	0.26±0.01	26.81±0.91	0.63±0.03	2.57±0.13	15.08±0.98	0.51±0.04
Pd - Au	0.36±0.01	37.69±1.23	0.54±0.02	4.97±0.15	28.36±1.19	0.59±0.03
Pt - Au	0.28±0.01	22.22±0.99	0.51±0.03	2.75±0.12	19.35±0.92	0.71±0.05
Pd - Pt	0.27±0.01	31.91±1.07	0.67±0.03	2.29±0.19	12.45±1.12	0.55±0.04

Table S4. Conductance measurement of anti-DNP antibody with different materials

Polarized potential (mV)	Peak I			Peak II			Peak III		
	Position (nS)	Height (Counts)	Half Width (Log G)	Position (nS)	Height (Counts)	Half Width (Log G)	Position (nS)	Height (Counts)	Half Width (Log G)
-223 mV	0.28±0.01	39.74±1.15	0.45±0.02	3.02±0.32	17.82±1.09	0.61±0.09	13.49±1.41	12.96±2.01	0.41±0.07
-200 mV	0.28±0.01	35.00±1.24	0.37±0.02	3.31±0.25	17.14±0.97	0.80±0.05	13.90±1.24	7.96±1.47	0.39±0.02
-158 mV	0.31±0.01	42.85±1.10	0.42±0.02	3.96±0.25	21.28±1.12	0.75±0	16.50±1.06	9.86±1.32	0.40±0.06
-100 mV	0.24±0.01	28.78±1.08	0.61±0.04	1.99±0.09	21.70±1.23	0.51±0.05	9.89±0.40	16.60±1.46	0.30±0.04
0 mV	0.23±0.01	26.96±1.12	0.65±0.05	1.50±0.08	25.48±1.51	0.41±0.05	6.03±0.63	15.79±1.36	0.47±0.08
+120 mV	0.27±0.01	26.71±0.86	0.70±0.01	1.29±0.05	16.42±1.53	0.24±0.03	3.92±0.21	15.73±1.15	0.41±0.05

Table S5. Conductance as a function of surface polarization measurement of streptavidin system (Pd-Pd).

Polarized potential (mV)	Peak I			Peak II			Peak III		
	Position (nS)	Height (Counts)	Half Width (Log G)	Position (nS)	Height (Counts)	Half Width (Log G)	Position (nS)	Height (Counts)	Half Width (Log G)
1st 0 mV	0.26±0.01	29.49±0.93	0.50±0.02	1.45±0.04	24.74±1.08	0.36±0.03	6.11±0.26	15.40±1.03	0.39±0.04
2nd-223 mV	0.29±0.01	33.86±1.23	0.52±0.02	3.00±0.12	24.00±1.30	0.50±0.04	13.72±1.08	13.34±1.46	0.43±0.05
3rd 0 mV	0.26±0.01	35.37±1.16	0.44±0.02	1.47±0.04	30.18±1.24	0.44±0.03	6.61±0.19	21.23±1.39	0.29±0.03

Table S6. Reversibility measurement with polarization control