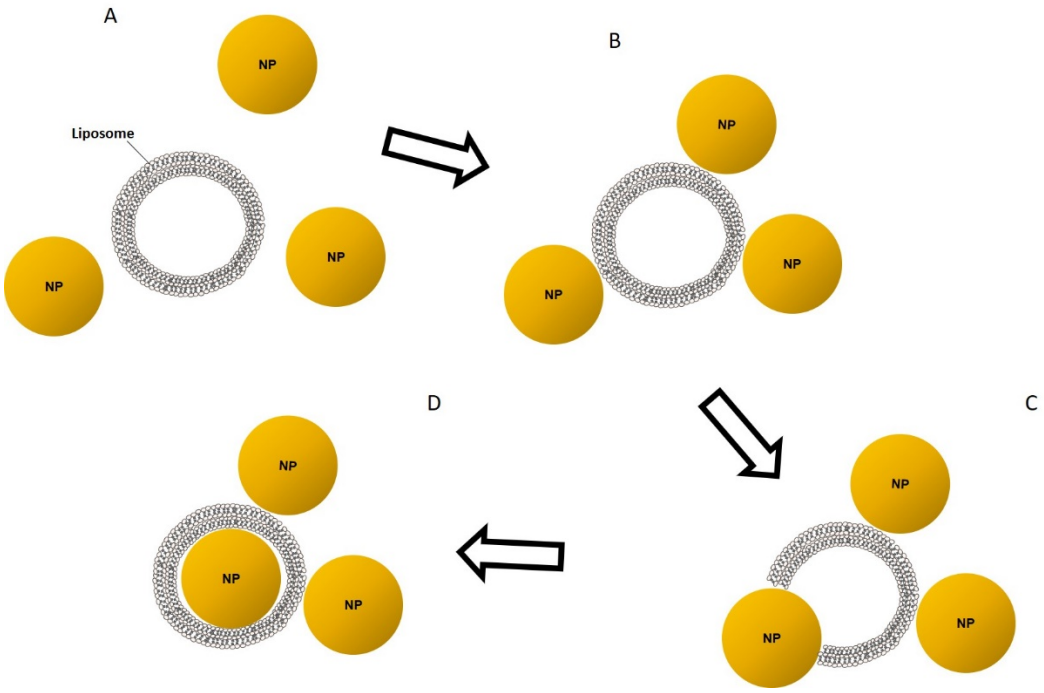
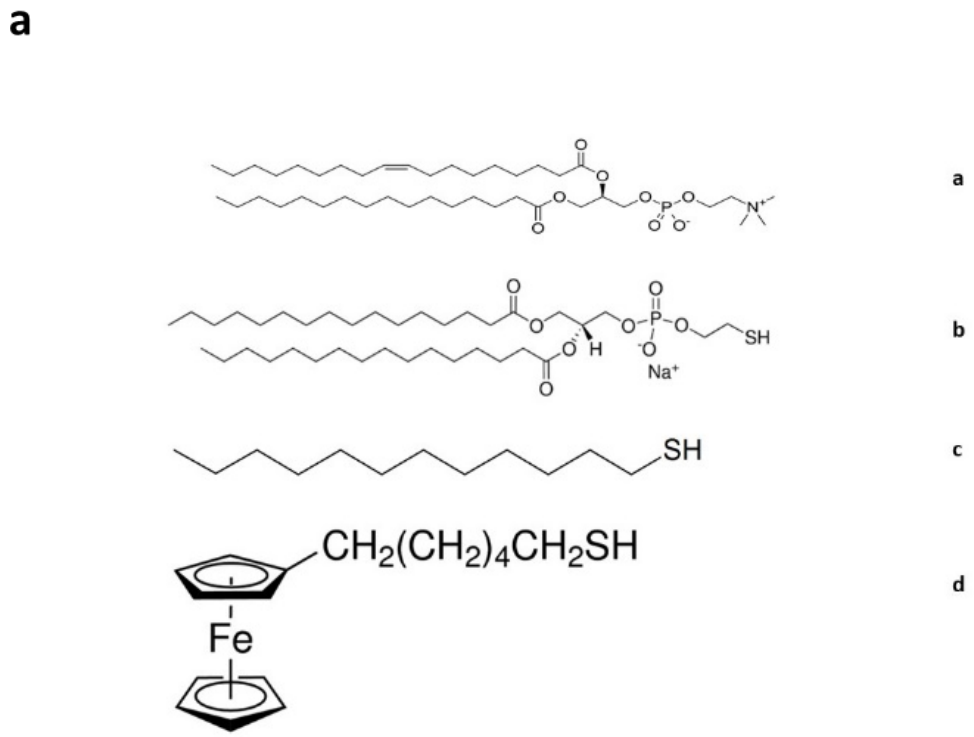
Supplementary Material:

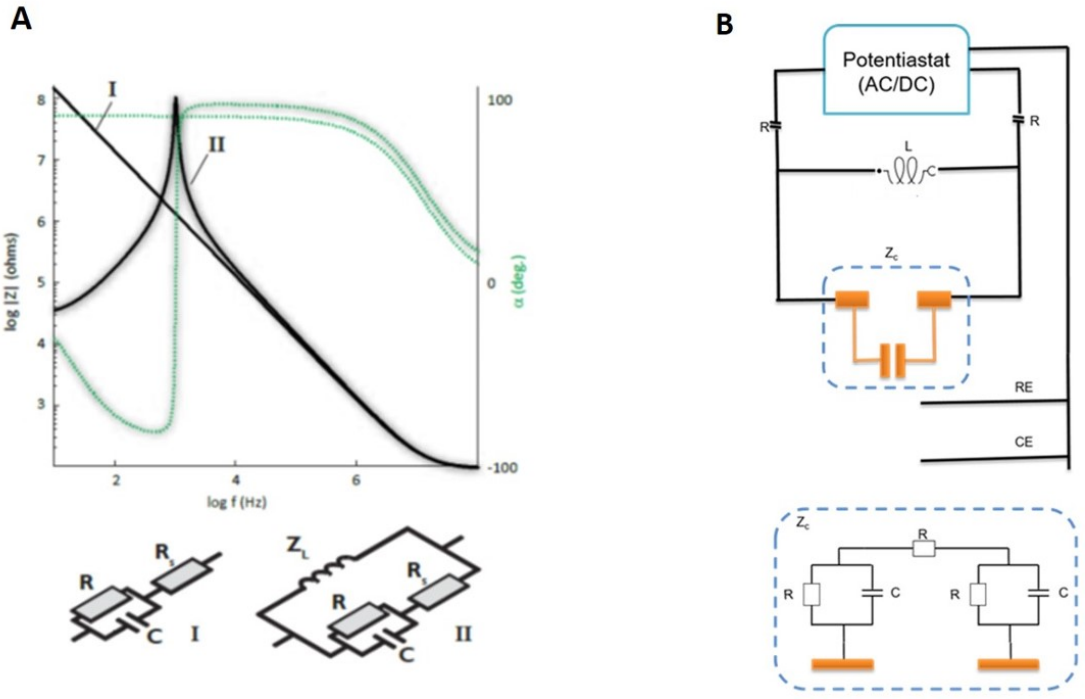


ESI Figure S1: Schematic illustration of the various types of NPs-membrane interactions; A) charged NPs approaching liposome (surface of lipid bilayer membrane), B) adhesion of NPs onto membrane surface, C) defect (pore) formation caused by NPs and D) NP encapsulation inside liposome. [1]



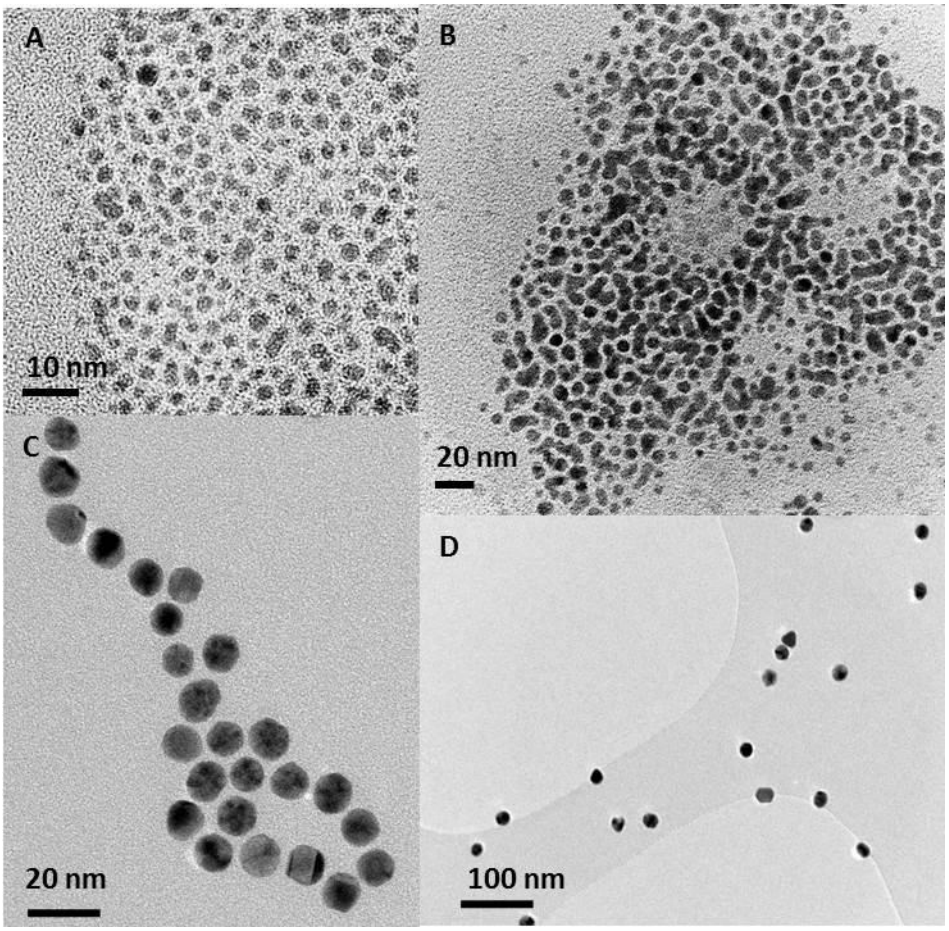
ESI Figure S2: Structures of (a) 2-oleoyl-1-palmityol-sn-glycero-3-phosphocholine (POPC), (b) 1,2-dipalmitoyl-sn-glycero-3-phosphothioethanol (DPPTE) , (c) 1-dodecanethiol , (d) 6-(Ferrocenyl)hexanethiol

ESI Section 1 : RESI technique & illustration

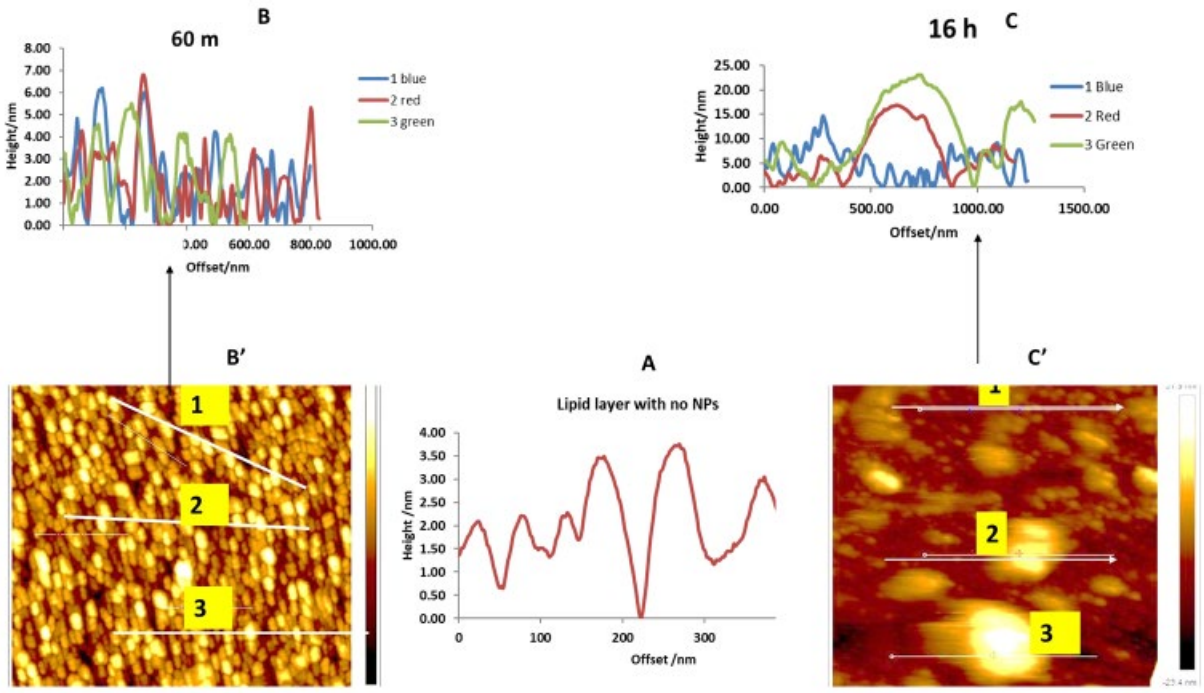


ESI Figure S3 A) Bode plot (phase angle α, impedance |Z|) to illustrate the effect of the inductive impedance (Z_L) connected in parallel with the sensor (circuit diagram II) and without it (circuit diagram I). A sharp resonance peak appears in the spectrum; the frequency of the peak varies with the capacitance C. B) An illustration of the z-LAB circuitry for the integrated sensor chip.

The integrated sensor chip is represented by an internal impedance Z_c, which is connected in parallel with an inductive impedance L (Figure S1B). The principal components of the sensor comprised resistors (R) and capacitors (C). The working electrodes on the sensor are immersed in the flow cell and can be connected to the reference electrode (RE) and counter electrode (CE). [2]



ESI Figure S4: Transmission electron microscopy (TEM) images of thiolated gold nanoparticles; A) DDT-AuNPs, B) 5nm FcHT-AuNPs, C) 10 nm FcHT-AuNPs and D) 20 nm FcHT-. AuNPs



ESI Figure S5: AFM images in tapping mode and height profiles of

A : Height profile of a lipid modified substrate with no Au NPs

B and B': Height profile and AFM image of lipid modified substrate in contact with DDTAuNpS for 1 h

C and C' : Height profile and AFM image of lipid modified substrate in contact with DDTAuNpS for 1 h

All images are 200 x 200 nm. [DDT-AuNPs] = 1.2 nM.

ESI Section 2

Theoretical calculation of number of ligands per nanoparticle.

Assuming that all particles are completely spherical and using the determined TEM diameter (*D*) ,the number of metal atoms per NP (*N*) was determined using the equation below from Liu and co-workers[1].

$$N = \frac{\pi}{6}\frac{\rho D^3}{M} \qquad \textbf{(A1)}$$

The atomic molar mass of the metal (*M*, Au = 197 g mol^{-1}) and the density of face-centered cubic (fcc) of the metal (Au = 19.3 g cm^{-3}).

Table SI1a. Determination of the number of atoms and ligands per NP.

Ligand	Average number of Au atoms
DDT	6.57×10^2
FcHT	5.20×10^3

Theoretical calculation of the molar concentration of NPs in the solution

The calculations for the molar concentration of the NPs (*C*) were adapted from Kalishwaralal and co-workers[3] using the equation below, assuming that 100% reduction of salt $HAuCl_4$ for AuNPs to Au atoms

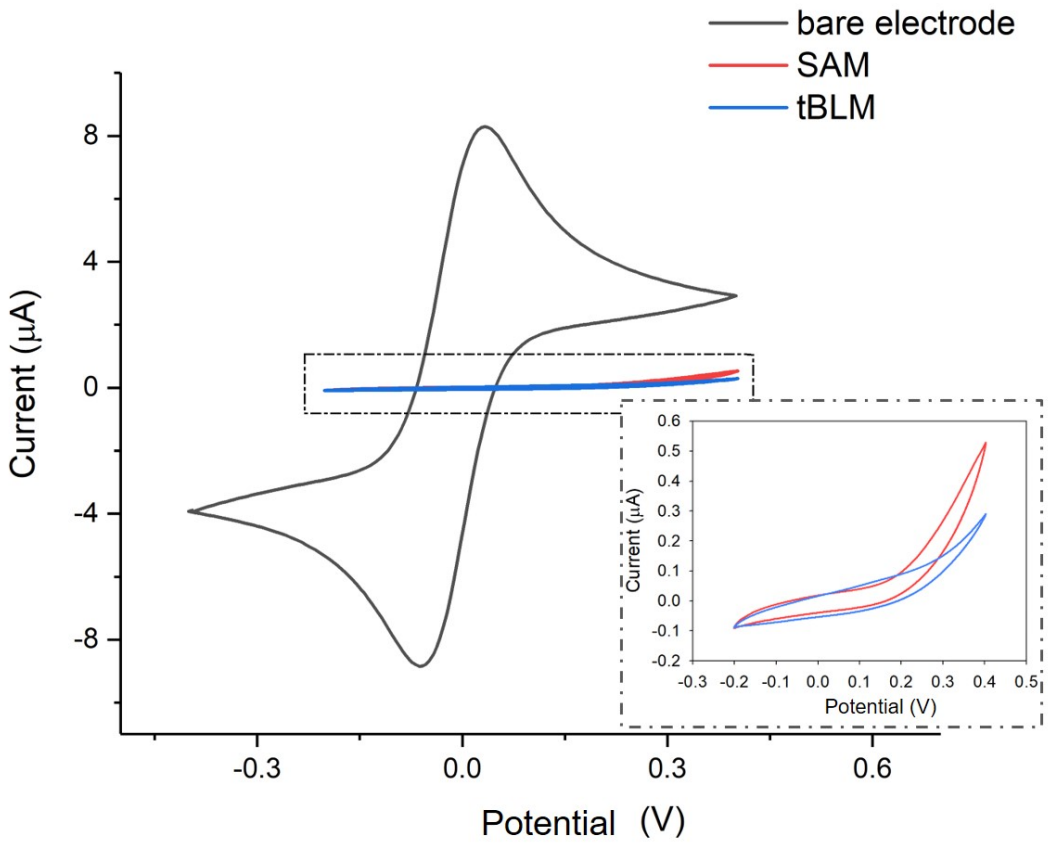
$$C = \frac{N_{Total}}{NVN_A} \qquad (\mathbf{A2})$$

The total number of metal atoms added i.e. the initial amount of salt ($AgNO_3$ for AgNPs and $HAuCl_4$ for AuNPs) added to the reaction (N_T, M), the number of metal atoms per NP determined from Eq. 3 (*N*) and the volume of the reaction solution (*V*, L).

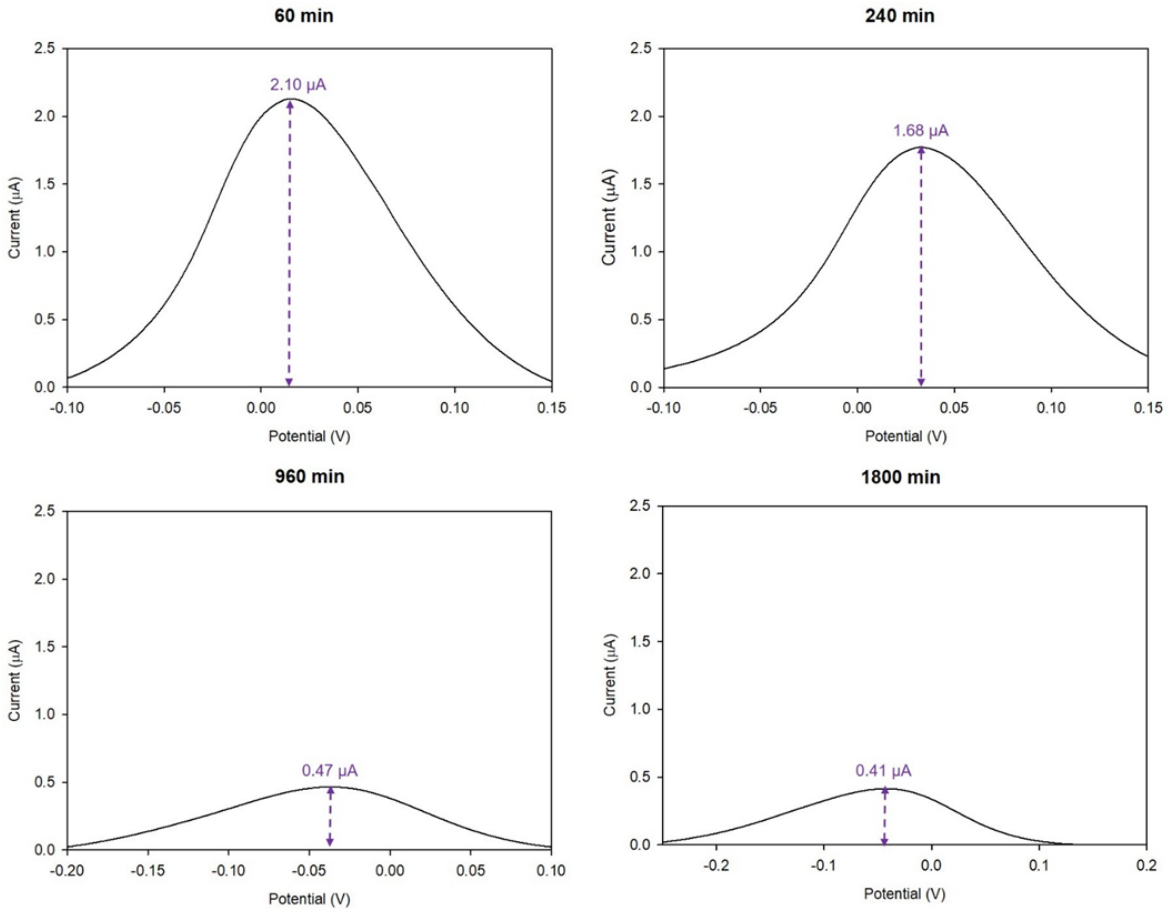
Table 1b. Determination of the molar concentration of NPs.

Ligand	**Molar concentration of AuNPs /µM**
DDT	3.38×10^2
FcHT	4.11

Further required concentrations were made out from the initial concentration determined above.



ESI Figure S6: CV of bare vs lipid-modified gold electrodes (0.02 cm^2) in solution of 10 mM $Fe^{3+}/4^+$ in 0.1 M KNO_3 at 50 mV/s scan rate showing formation of SAM and BLM on the electrode surface.



ESI Figure S7: DPVs of the SAM-modified gold electrode in 0.1 M KNO_3 at 60, 240, 960 and1800 min immersion times in FcHT-AuNPs. Sweep amplitude: 5 mV/s. [FcHT-AuNPs] = 2.8 µM.

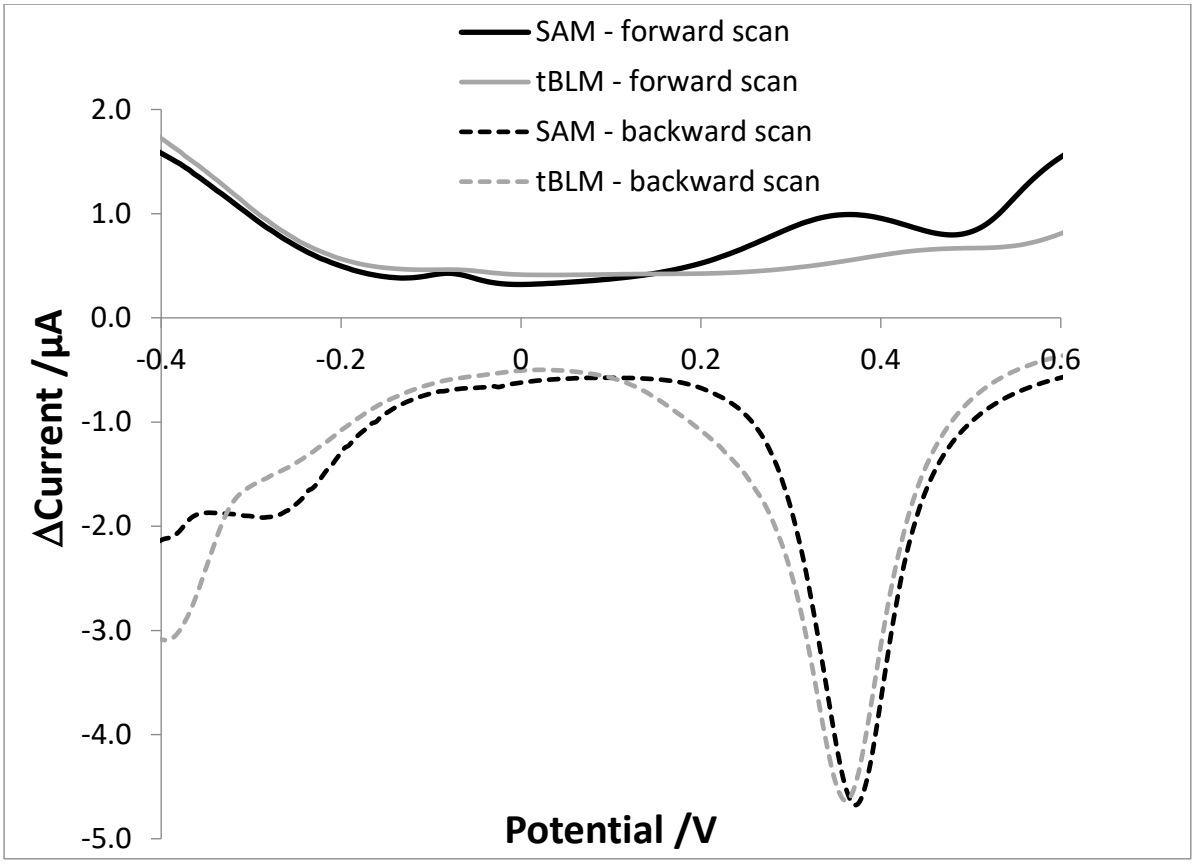


Fig ESI S8: DPVs of the electrochemical response of lipid modified gold electrodes after incubation in FcHT-AuNPs after 60 min in 0.1 M phosphate buffer at a potential of -0.1 V. The electrodes were taken out of the buffer solution, rinsed and DPV measurements in both forward and backward directions were taken in a background of 0. 1 M $NaClO_4$ at 100 mV/s scan rate. Sharp desorption peaks were observed, in the scans in the negative direction, at approximately 0.4 V,

References:

1. X. Liu, M. Atwater, J. Wang and Q. Huo, Colloids Surf. B Biointerfaces, 2007, **58**, 3–7.

2. A. Lundgren, J. Hedlund, O. Andersson, M. Brändén, A. Kunze, H. Elwing, F. Höök, . Resonance-Mode Electrochemical Impedance Measurements of Silicon Dioxide Supported Lipid Bilayer Formation and Ion Channel Mediated Charge Transport., Anal. Chem. 83 (2011) 7800–7806. https://doi.org/10.1021/ac201273t.

3 K. Kalishwaralal, S. Barath ManiKanth, S. R. K. Pandian, V. Deepak and S. Gurunathan, Colloids Surf. B Biointerfaces, 2010, **79**, 340–344.