Electronic Supplementary Material (ESI) for Nanoscale Advances.

Supplementary Information

Determination of sitagliptin in human plasma using a smart electrochemical sensor based on electroactive molecularly imprinted nanoparticles

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1. Dansyl Chloride (DNSCL) Test

Silanisation of glass beads was confirmed by dansyl chloride test. To perform this test 10 mg of DNSCL was dissolve in 1 mL of ethanol and 0.5 g of silanized glass beads was immersed in this solution for 1 hour in dark. Similarly 0.5 g of non-silanized glass beads was immersed in DNSCL solution for 1 hour in dark. After 1 hour washed these glass beads with ethanol/acetone to remove dansyl chloride and checked its fluorescence under UV lamp. Non-silanised glass beads were non-fluorescent while silanized glass beads were fluorescent in UV lamp, which confirmed the successive silanization of glass beads as shown in the Figure S2.

Figure S1. The presence of amino groups on the solid phase was confirmed using the DNSCL test.

2. Materials and Methods

Table S1. Different composition of polymerization mixture.

Monomer	Function	nanoMIP-1	nanoMIP-2
Iniferter	Initiator, transfer agent, and terminator	0.75 g (3.14 mmol)	0.75 g (3.14 mmol)
PETMP	Chain transfer agent	0.18 g (0.37 mmol)	0.18 g (0.37 mmol)
FcMMA	Electroactive monomer, redox label	0.17 g (27.1 mmol)	0.17 g (27.1 mmol)
NIPAM	Thermo-responsive properties	0.02 g (0.17 mmol)	0.02 g (0.17 mmol)
EGMP	Functional monomer	7.03 g (33.47 mmol)	7.03 g (33.47 mmol)
TFMAA	Functional monomer	-	*4.122 g (29.43 mmol)*
MAA	Functional monomer	*1.44 g (16.35 mmol)*	-
NAPMA	Functional monomer	0.02 g (0.17 mmol)	0.01 g (0.085 mmol)
MBA	Cross-linker/ Functional monomer	2.52 g (16.35 mmol)	2.52 g (16.35 mmol)
EGDMA	Cross-linker	3.24 g (16.35 mmol)	3.24 g (16.35 mmol)
TRIM	Cross-linker	3.24 g (9.57 mmol)	3.24 g (9.57 mmol)

3. Result and Discussion

Table S2. Binding energy for Sitagliptin with the monomer database

Monomers	Binding Score, kJmol^{-1}
TFMAA	*-37.60*
MBA	-31.84
EGMP	-29.32
MAA	*-28.18*
NAPMA	-26.73

a **b**

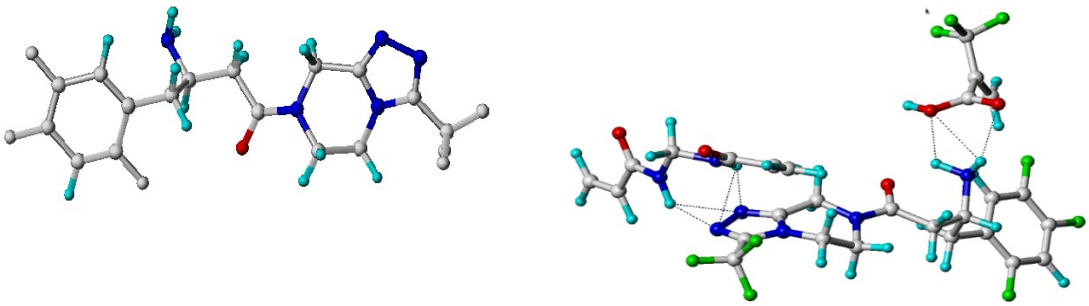

Figure S2. Minimized structure of (a) sitagliptin and (b) MBA-sitagliptin-TFMAA complex.

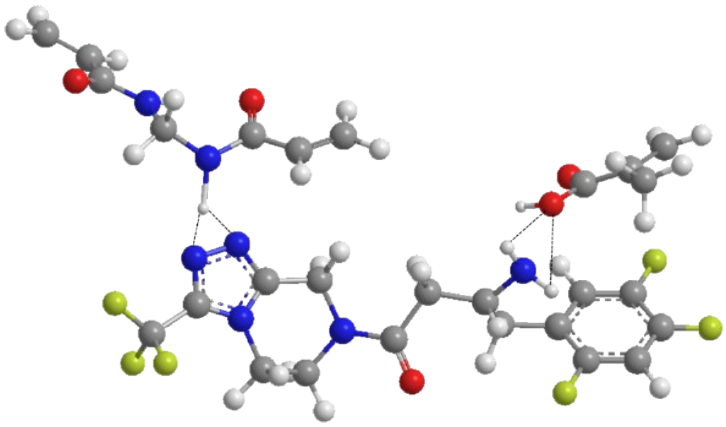

Figure S3. (a) Minimized structure of MBA-Sitagliptin-MAA complex

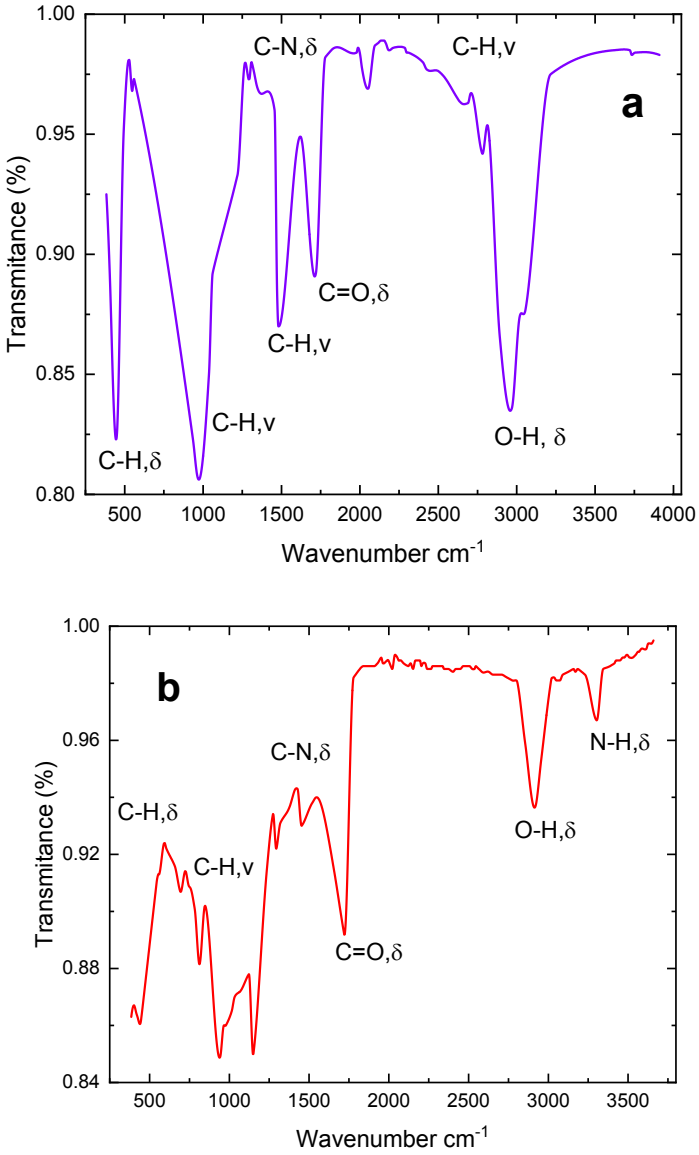

Figure S4. FTIR spectra of (a) nanoMIP 1 and (b) nanoMIP 2.

Table S3. The size measurements of nanopMIPs, (n=5)

nanoMIP	DLS Analysis		TEM Analysis
	Diameter (nm)	Polydispersity index (PDI)	Diameter (nm)
MIP-1	233 ± 5.8	0.32 ± 0.06	15 ± 4.5
MIP-2	193 ± 9.5	0.36 ± 0.05	21 ± 3.2

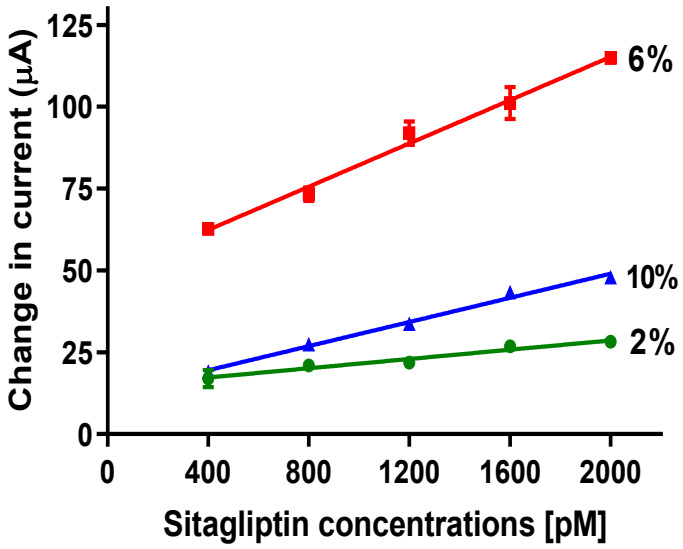

Figure S5. The effect of APTES concentration (2%, 6% and 10%) on SPPE. Experiments were performed in a concentration range from 400 to 2000 pM in PBS and measurement were repeated 3 times.

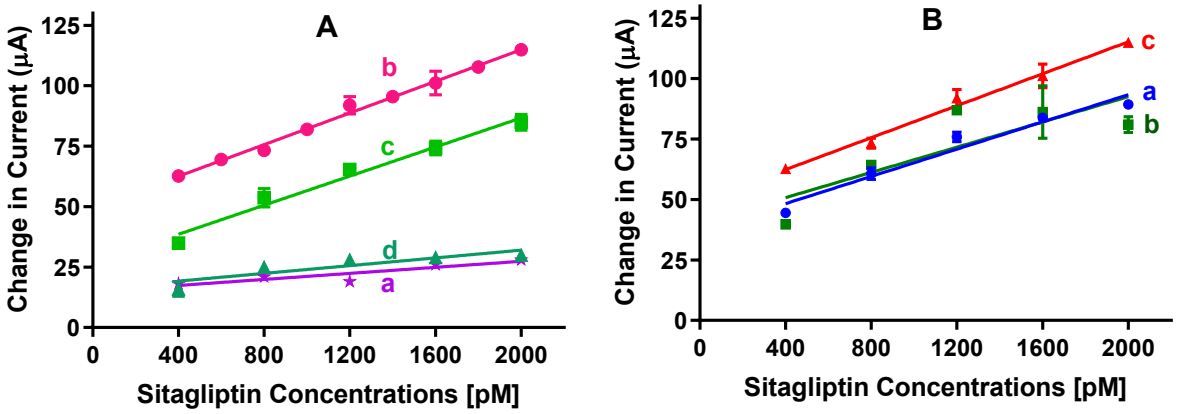

Figure S6. (A) The sensors response to Sitagliptin prepared with nanoMIP concentration at (a) 0.3, (b) 0.5, (c) 0.7 and (d) 1 mg mL^{-1} on SPPE. (B) Sensor response to Sitagliptin prepared at different immobilization times of nanoMIP (a) 2, (b) 4 and (c) 20 h on SPPE. Experiments were performed in a concentration range from 400 to 2000 pM in PBS and measurement were repeated 3 times.

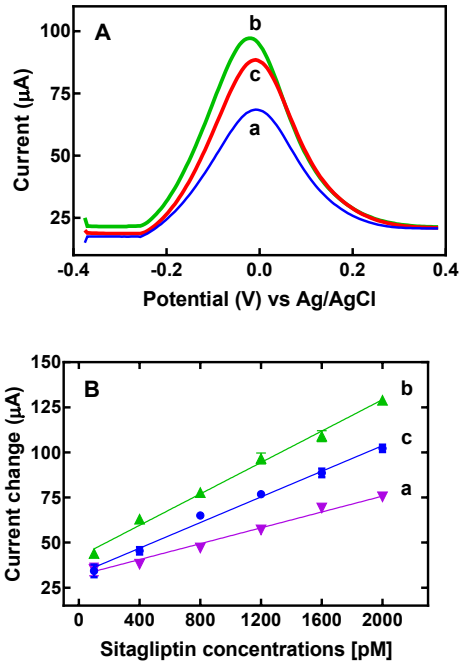

Figure S7. NanoMIP sensor response for different FcMMA monomer concentration at (a) 15, (b) 20, and (c) 25 molar %. Plot A, sensor response to 1200 pM of Sitagliptin in 5 mM PBS buffer and Plot B, calibration curve from 100 to 2000 pM Sitagliptin in 5 mM PBS buffer.

Table S4. Performance of the nanoMIP sensor

Parameter	Level	Sensitivity (nA pM $^{-1}$)	Linearity (R^2)
nanoMIP Concentration (mg mL^{-1})	0.3	6.2	0.810
	0.5	*32.7*	*0.993*
	0.7	30.0	0.977
	1	8	0.793
nanoMIP immobilization time (h)	2	28.2	0.954
	4	26.1	0.679
	20	*33*	*0.991*
APTES Concentration (%)	2	7.1	0.960
	6	*33*	*0.990*
	10	18.4	0.990
FcMMA (molar %)	15	35.5	0.996
	20	*43.5*	*0.998*
	25	22	0.989

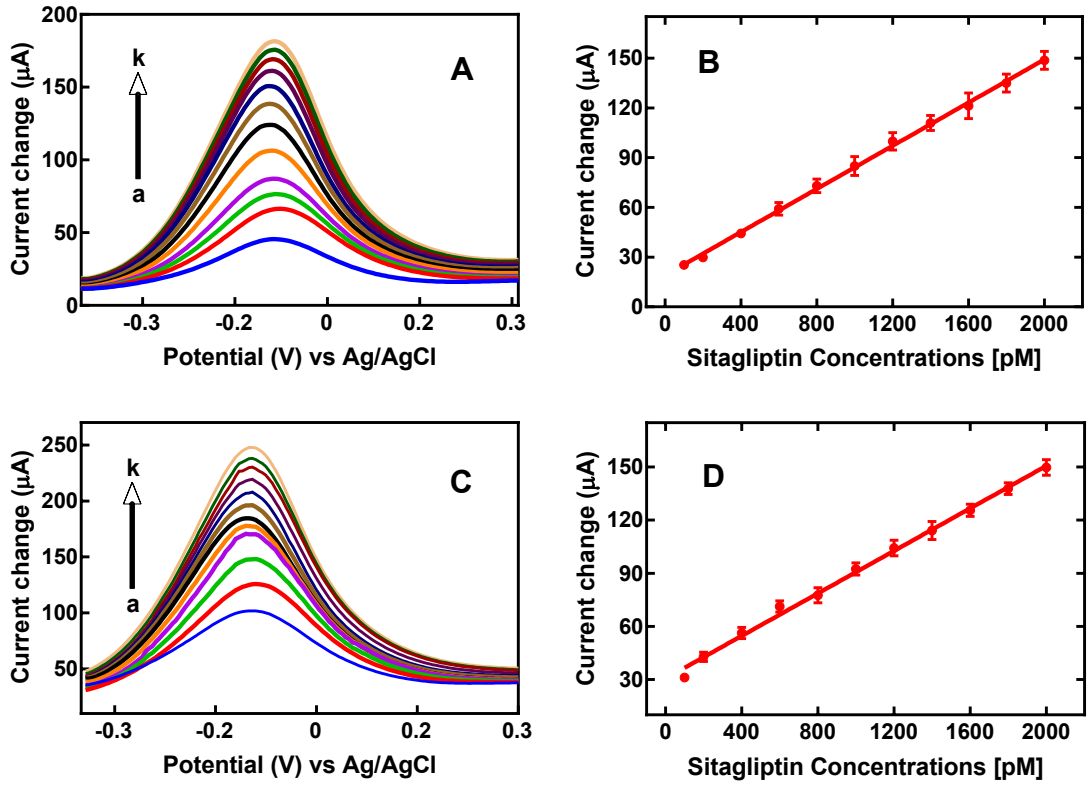

Figure S8. NanoMIP-1 sensor response (A), and the corresponding (B) calibration curve. NanoMIP-2 sensor response (C), and the resultant calibration curve (D). Experiments (n=3) were performed in a sitagliptin concentration at (a) 0, (b) 100, (c) 400, (d) 600, (e) 800, and (f) 1000, (g) 1200, (h) 1400, (i) 1600, (j) 1800 and (k) 2000 pM in PBS.

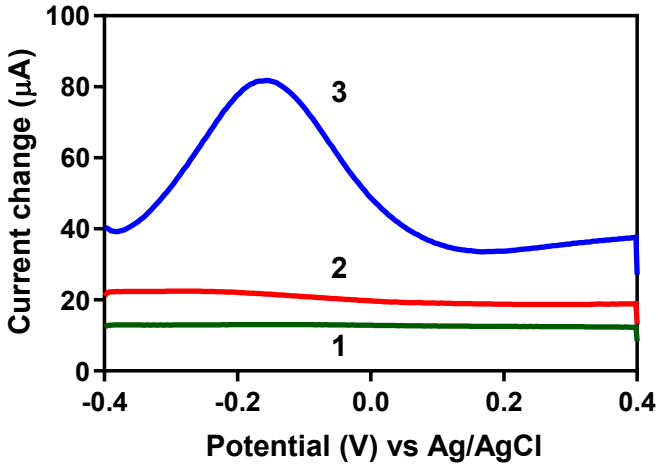

Figure S9. DPV response to (1) 5 mM PBS buffer and (2) 2.45 mM Sitagliptin on bare electrode, SPPE. (3) NanoMIP modified SPPE in 5 mM PBS buffer.

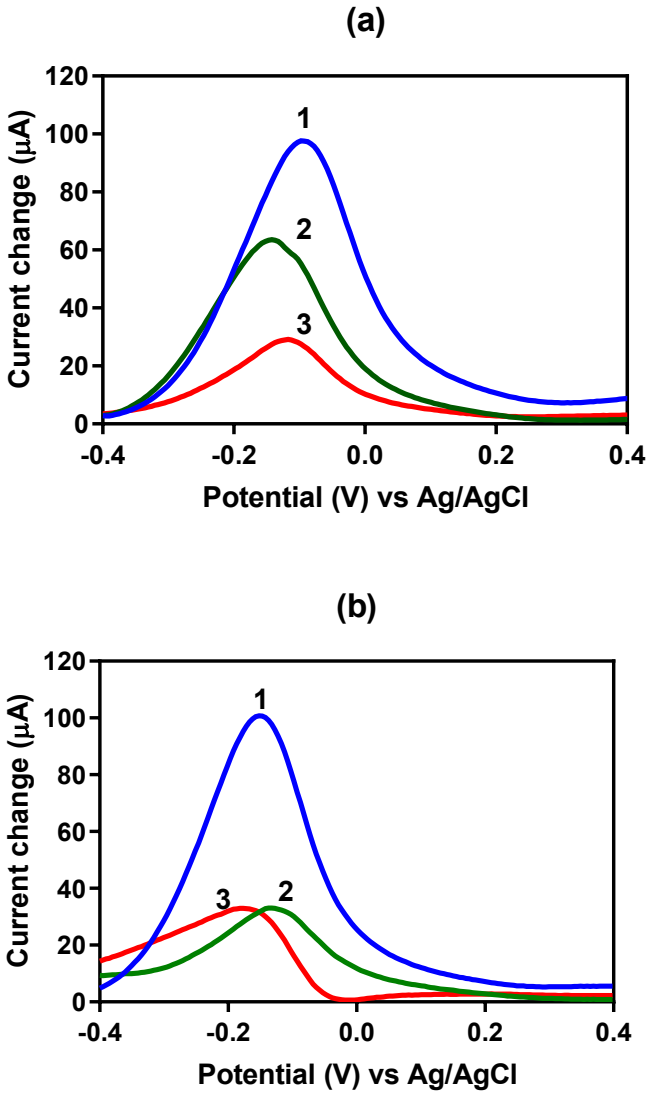

Figure S10. The DPV response recorded for (a) nanoMIP-1 and (b) nanoMIP-2 to (1) Sitagliptin, (2) Metformin, (3) Paracetamol. The drugs were tested at 1200pM in 5 mM PBS.

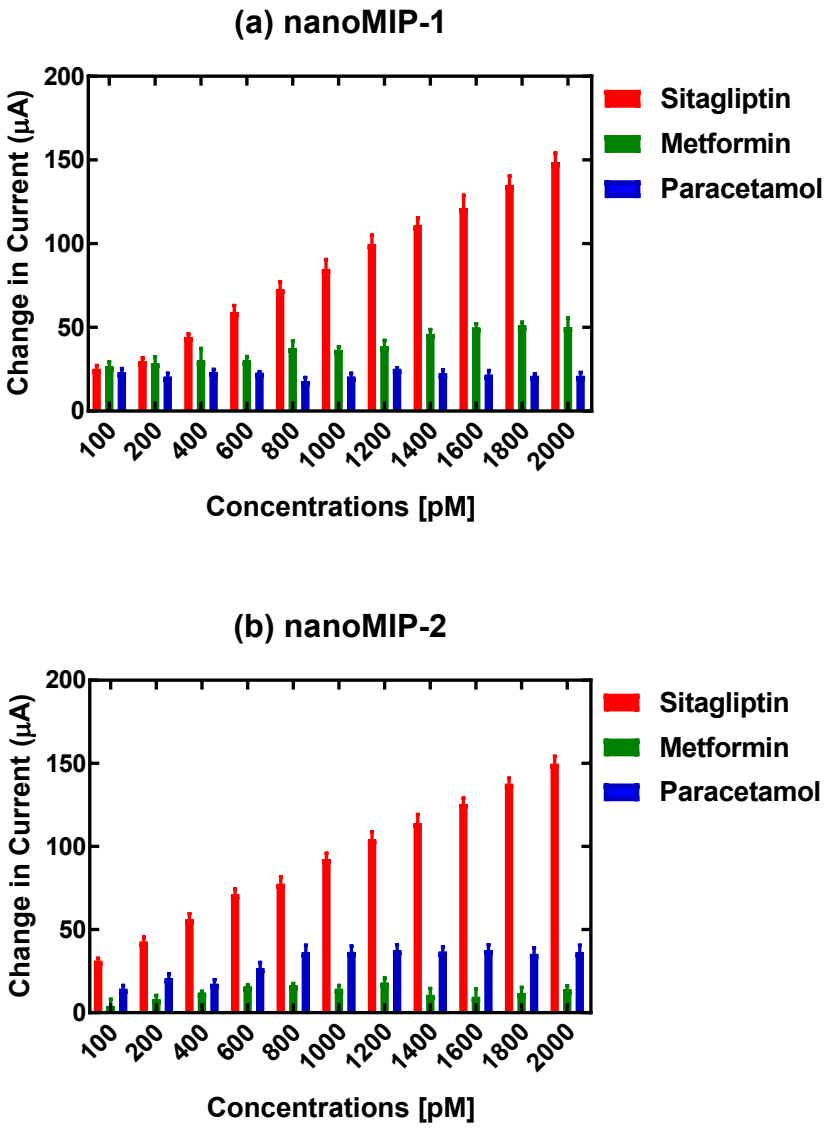

Figure S11. A comparison of the cross reactivity response between (a) nanoMIP-1 and (b) nanoMIP-2 towards metformin and paracetamol solutions under similar optimum conditions.

Table S5. Cross reactivity of fabricated nanoMIP sensors.

Sensor response		Sitagliptin	Metformin	Paracetamol
nanoMIP-1	Slope (nA pM $^{-1}$)	65 ± 1	14 ± 1	-0.3 ± 1
	Linearity (R^2)	0.998	0.857	0.011
	Sensor response	100%	21.5%	0.5%
nanoMIP-2	Slope (nA pM $^{-1}$)	60 ± 1	2.1 ± 2	11.5 ± 2
	Linearity (R^2)	0.996	0.117	0.687
	Sensor response	100%	3.5%	19.2%

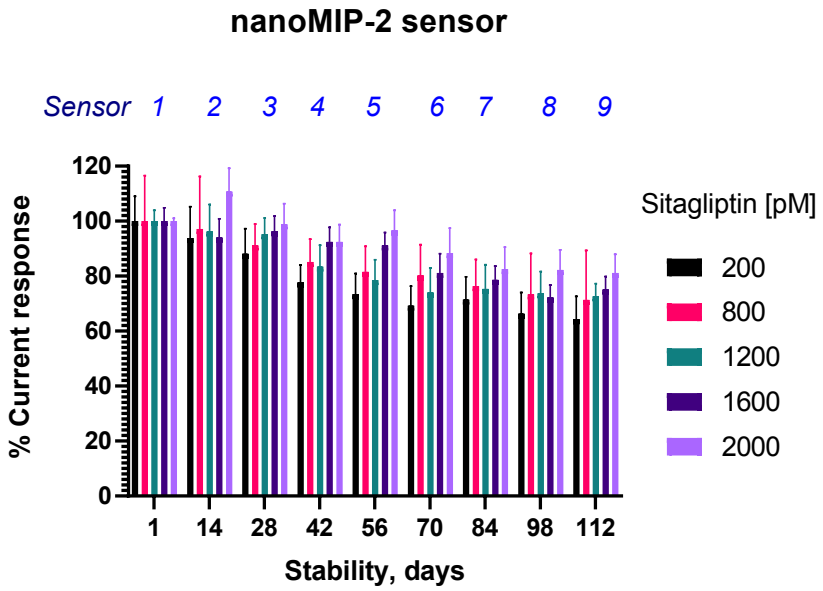

Figure S12. Percentage of the current response against days of storage of nanoMIP-2 sensor.