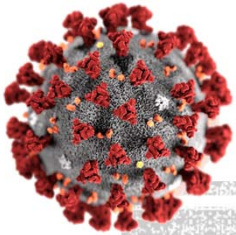
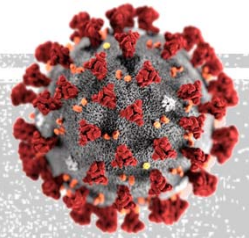
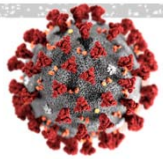


Ultra-Fast Viral Detection NanoSystem



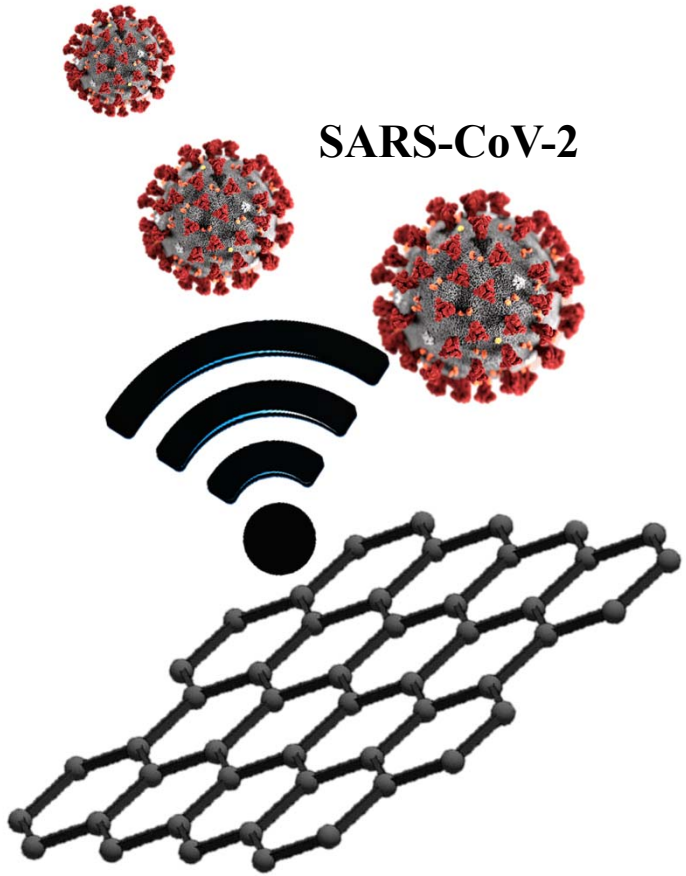


1

- Detection of SARS-CoV-2 in 1 minute
- Getting a unique peak for each virus
- Ultra-low detection limit
- High sensitivity toward viruses

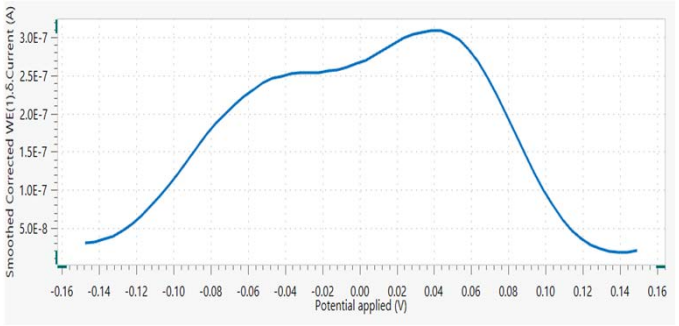
Rapid Nanosystem

- The developed nanosensor is consisted of highly activated 2D carbonic nanoflakes coupled with metallic peak intensifier
- The developed nanosystem has a fantastic sensitivity toward detection of pathogenic viruses
- It can detect viruses through active chains of their glycoproteins
- It can detect target pathogenic viruses in 1 minute
- Its based on the electrochemical approach
- It can even detect small viral glycoprotein parts within biological and non-biological media; detection limit of 1.68×10^{-22} $\mu g.mL^{-1}$ toward detection of SARS-CoV-2
- It can be used for detection of virus in swab, saliva and blood
- It can detect several viruses at the same time
- It can measure the population of viruses via accurate calibration curve

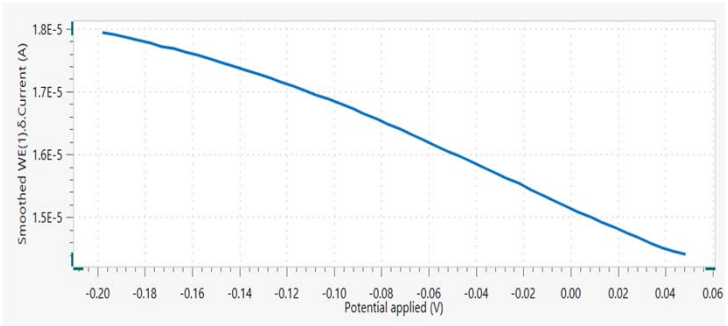


How it works

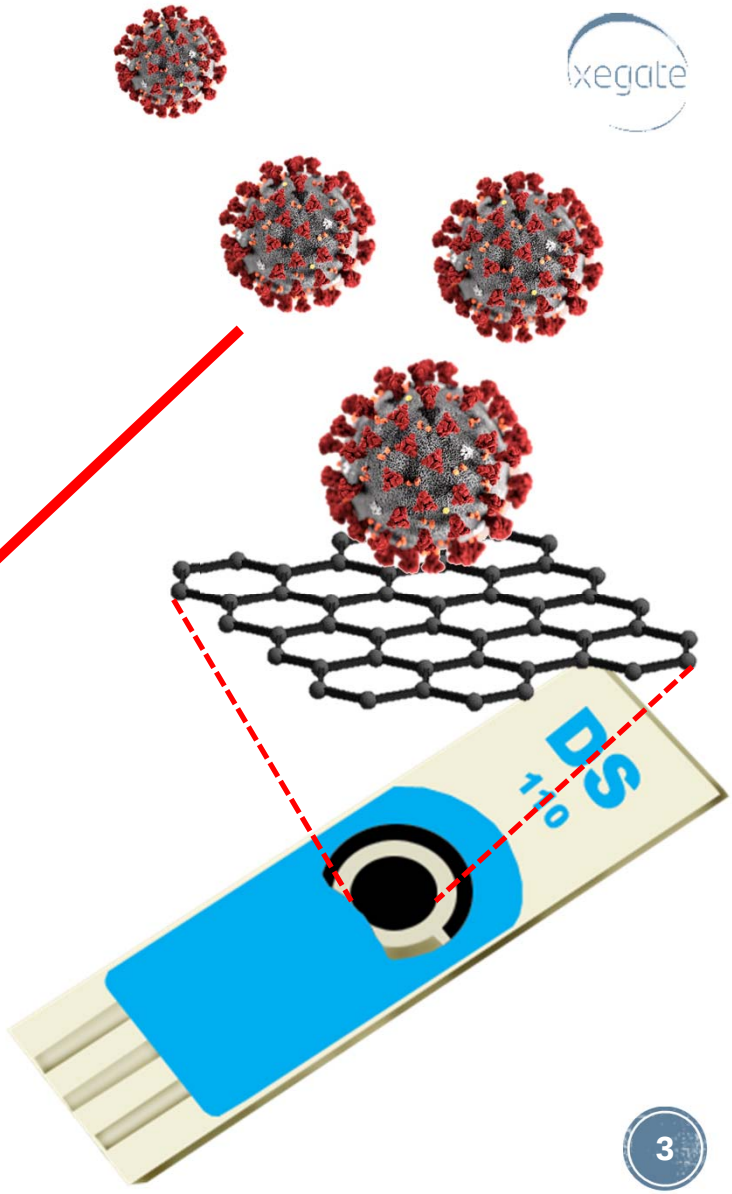
- The system is easy to use:
- First we activate the working electrode of screen-printed electrodes with the activating nanomaterials
- Thence we fully prepare the electrode and apply it to the device
- Then we directly add 100 µL of either swab, blood or saliva sample on it
- Then we run the DPV analysis of the device
- Now we can get the outcome in1 minunte!



Positive



Negative



How it works

DEMO VIDEO

Compared with other tests

Compared with ELISA

Parameter	Formula	Obtained Percentage (%)
Sensitivity	TP/TP+FN	100
Specificity	TN/TN+FP	85
Negative prediction value	TN/TN+FN	100
Positive prediction value	TP/TP+FP	86.95
False negative rate	FN/FN+TP	0
False positive rate	FP/FP+TN	15
False discovery rate	FP/FP+TP	13.04
Accuracy	(TP+TN)/P+N	92.5
False negative rate	FN/P	0
False positive rate	FP/N	15

TP: true positive, FP: false positive, TN: true negative, FN: false negative, P: positive and N: negative; 40 samples were evaluated compared with ELISA, with 20 positive and 20 negative samples.

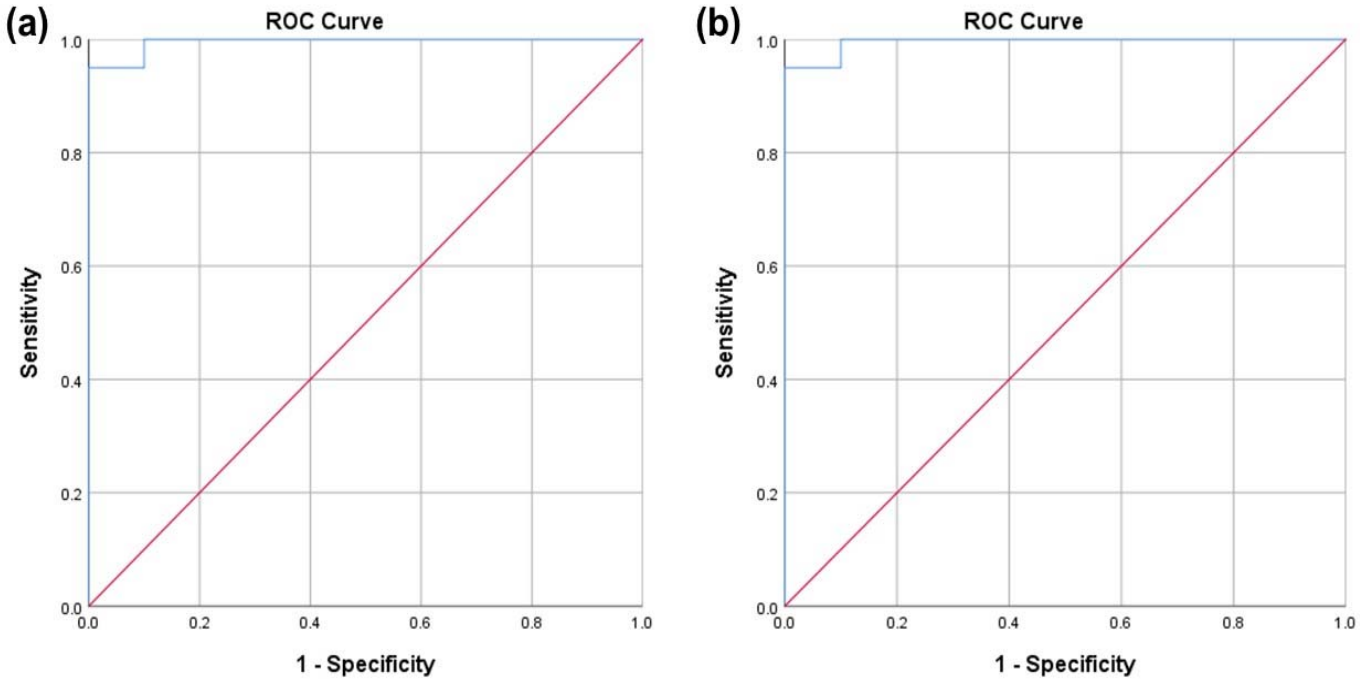
Compared with RT-PCR

Parameter	Formula	Percentage compared with RT-PCR (%)
Sensitivity	TP/(TP + FN)	95
Specificity	TN/(TN+FP)	60
Accuracy	(TP+TN)/(P+N)	81
False negative rate	FN/P	5
False positive rate	FP/N	40

TP: true positive, FP: false positive, TN: true negative, FN: false negative, P: positive and N: negative; 100 samples were evaluated by using RT-PCR, where 60 and 40 of them were found to be positive and negative, respectively; compared with RT-PCR, nanosensor showed following results: TP: 57, FP: 16, TN: 24 and FN: 3.

Please note that RT-PCR shows too many false negatives (between 30 to 60% based on the quality of kits, extraction and sampling quality) and due to that the specificity of the nanosensor is 60% compared with RT-PCR for the higher sensitivity and better detection limit of our nanosensor, because our nanosensor detects more infected people.

ROC Curve



ROC curves related to (a) performance of the nansoensor toward detection of S1 proteins within blood samples and (b) correlation between the nanosensor and ELISA kits' outcomes.

Positive if Greater Than or Equal To[a]	Sensitivity	Specificity
-1.000	100%	0%
0.0760	100%	70%
0.1605	100%	75%
0.1750	100%	80%
0.2185	100%	85%
0.2585	100%	90%
0.2615	95%	90%
0.2740	95%	95%
0.3265	95%	100%
0.3675	90%	100%
0.4175	85%	100%
0.4695	80%	100%
0.5030	75%	100%
0.5465	70%	100%
0.5645	65%	100%
0.5810	60%	100%
0.6090	55%	100%
0.6365	50%	100%
0.6585	45%	100%
0.6760	40%	100%
0.6870	35%	100%
0.6945	30%	100%
0.6980	25%	100%
0.7075	20%	100%
0.7185	15%	100%
0.7385	10%	100%
0.8370	5%	100%
1.9180	0%	100%

Based on the ROC Curve:

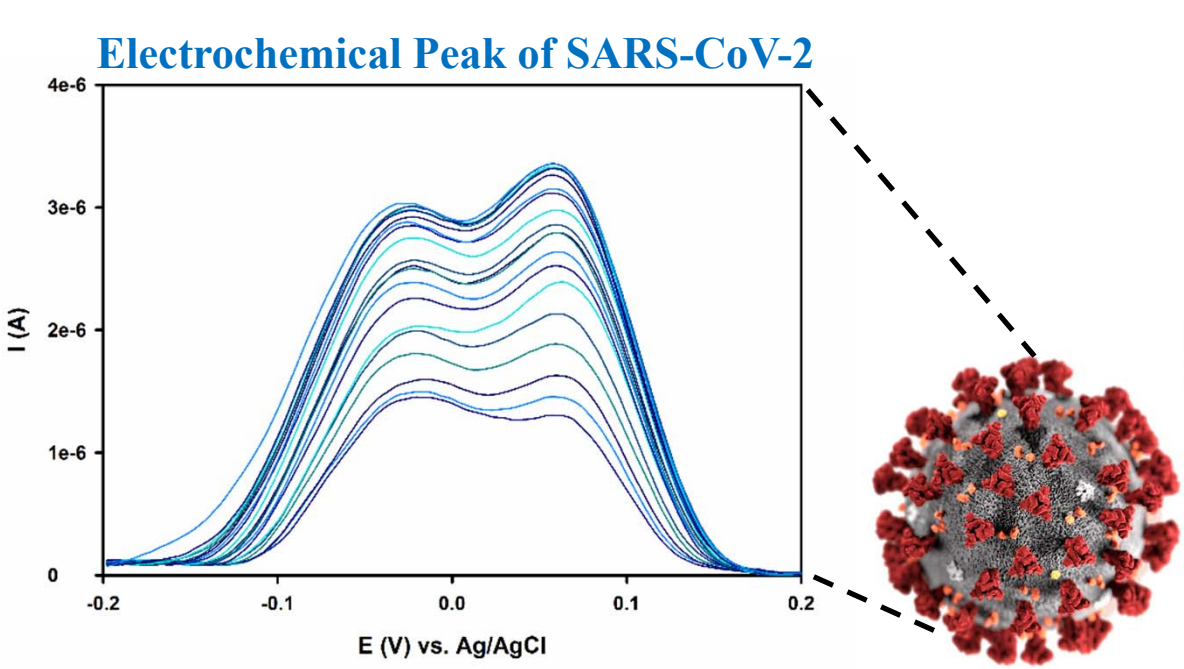
The sensor has sensitivity of 100% and specificity of 85% at cutoff point of 0.2185 µA

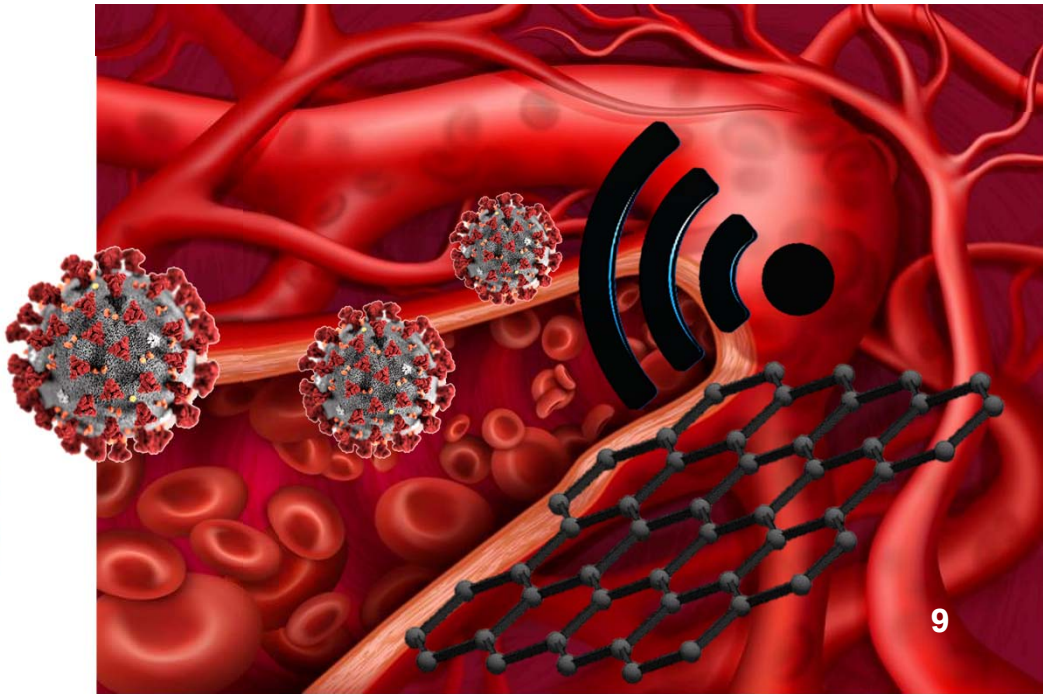
The sensor could present specificity of 100 % at cutoff point of 0.3265 µA, but the sensitivity will decline to 95%.

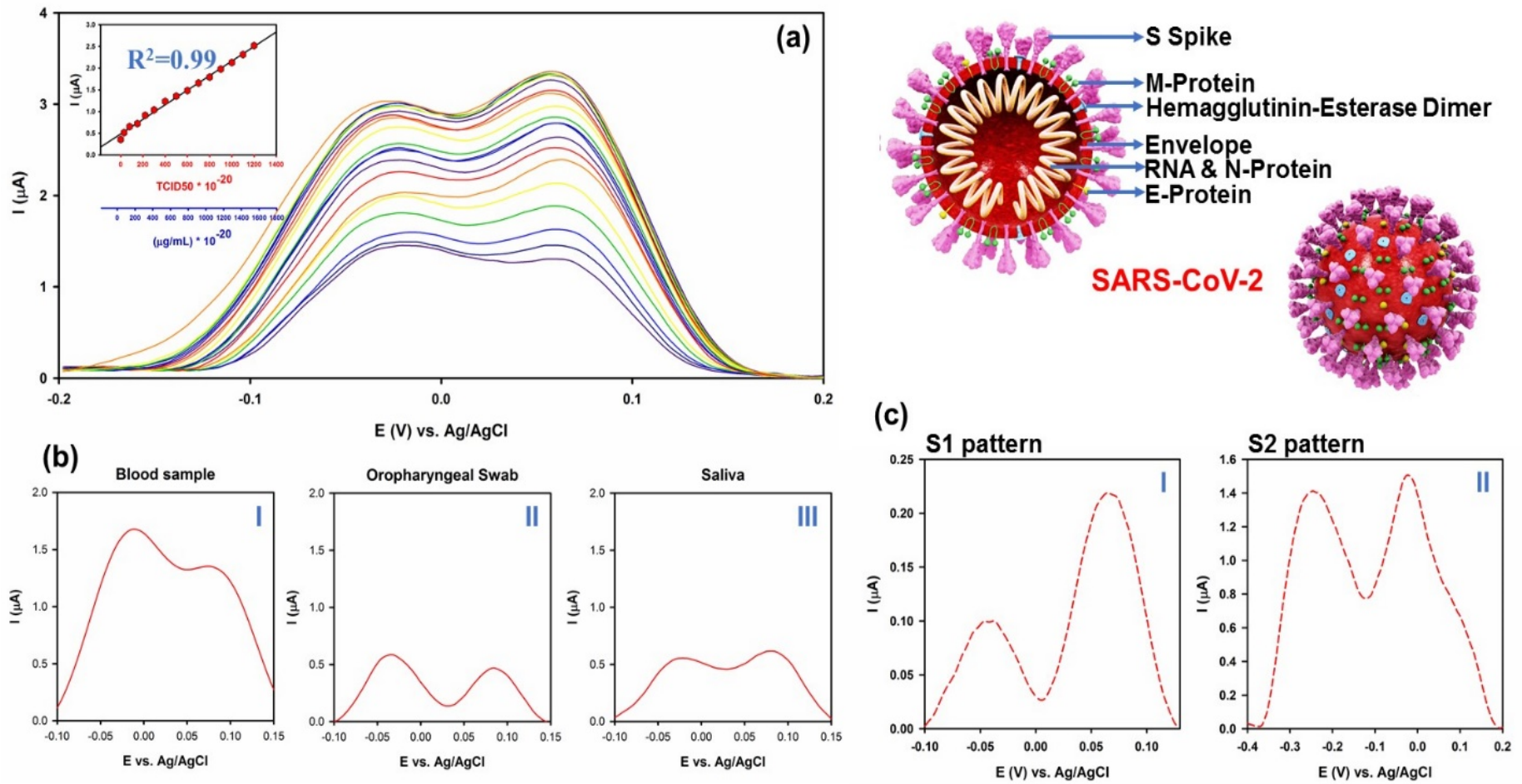
It shows that the sensor could be a fast screening platform or a diagnostic kit for confident detection of ill people with COVID-19.

How we calibrate ?

- First we provide pure antigen of virus with known concentration
- Thence we spike different dilutions of the virus into the buffer and get its unique electrochemical peak
- We consider it as positive control
- The intensity of peak corresponds to the concentration of virus in the media

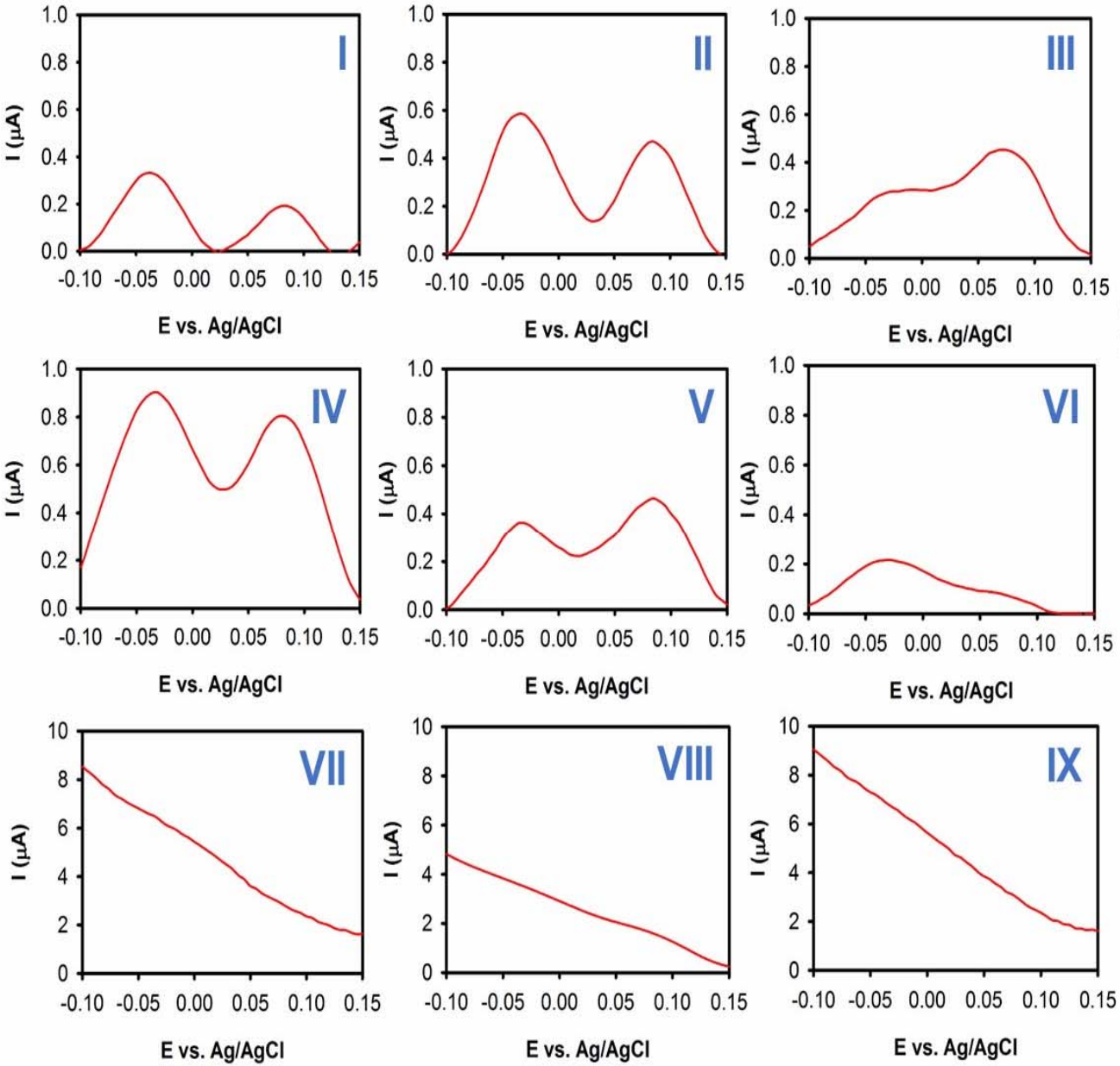


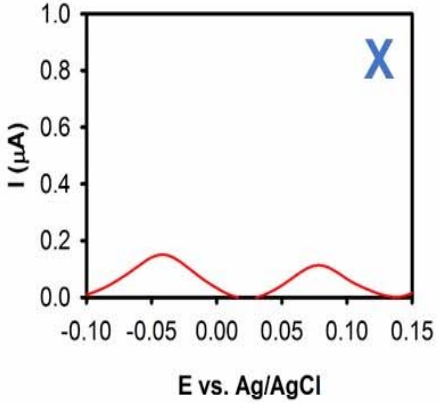


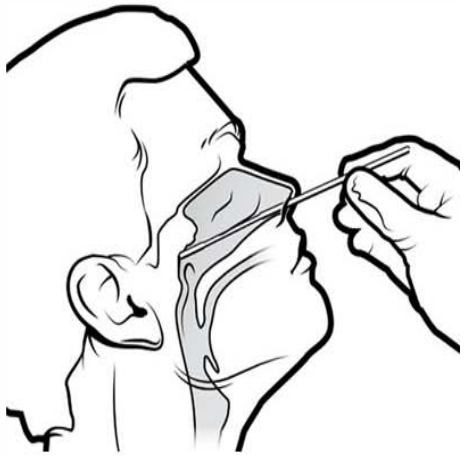


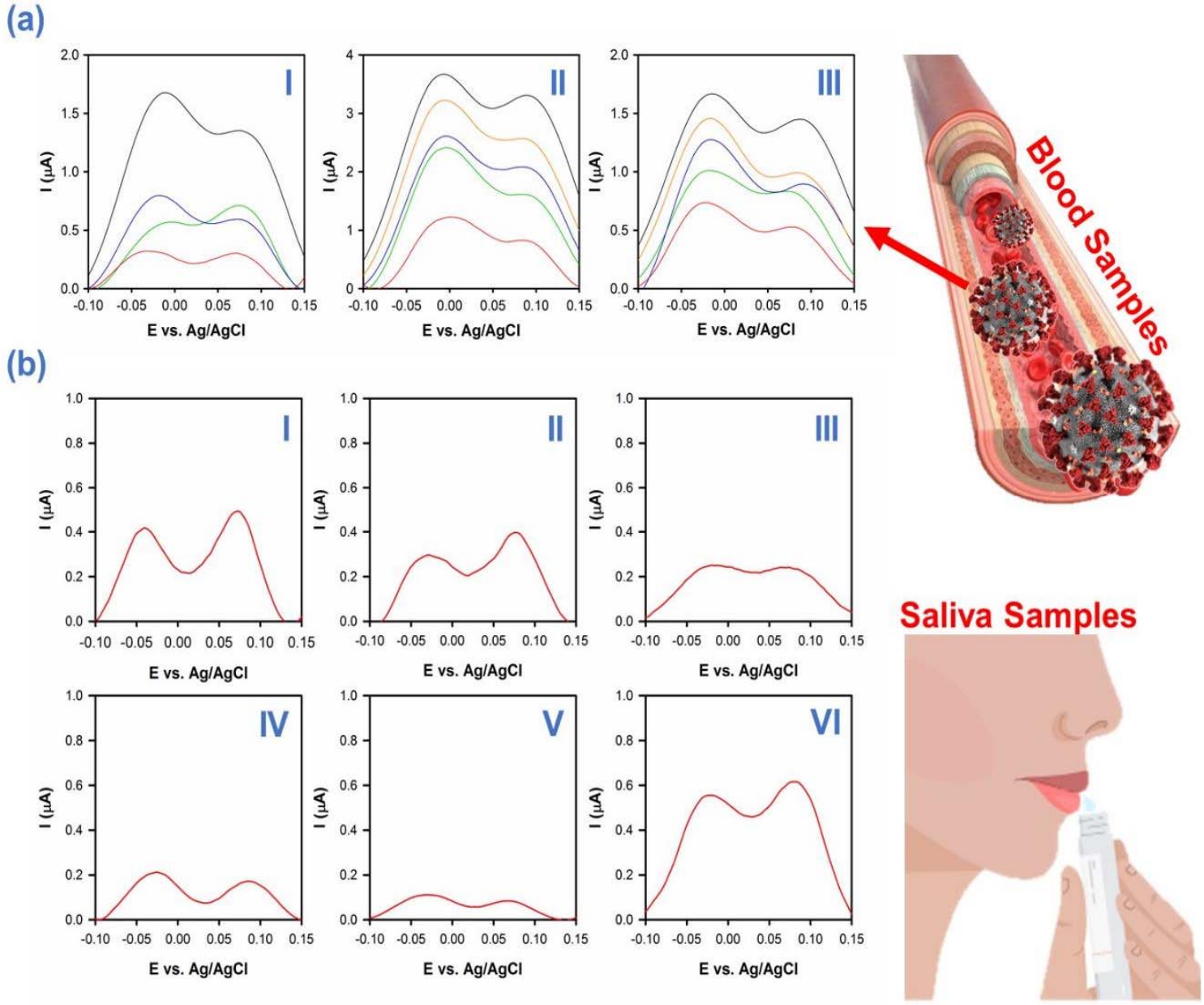
(a) DPV pattern of SARS-CoV-2 virus in PBS (pH=7.4) along with its respective calibration curve and structure of SARS-CoV-2 virus, (b) DPV pattern of SARS-CoV-2 in obtained samples from (I) blood, (II) oropharyngeal swab and (III) saliva of an infected person; and (c) obtained DPV patterns from (I) S1 and (II) S2 glycoproteins' antigen related to S spike glycoprotein of SARS-CoV-2 virus.

Swab samples







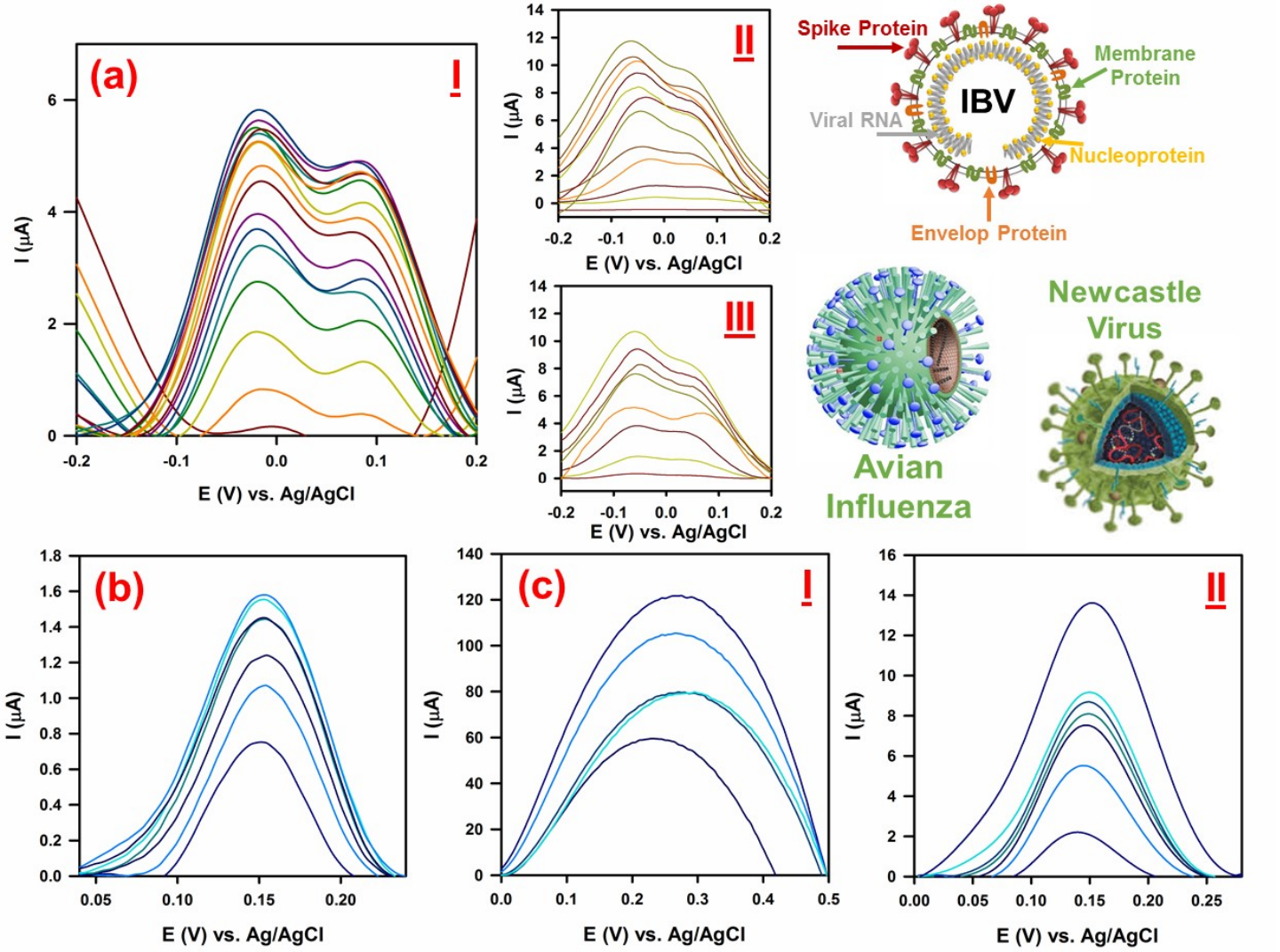

(a)
I
II
III
I (μA)
E vs. Ag/AgCl
(b)
IV
V
VI
Blood Samples
Saliva Samples

Benefits

- Rapid detection of calibrated pathogenic viruses on the device based on the applied step potential-1 min
- Ultra-high sensitivity toward detection of viruses
- Ultra-high accuracy
- Tunable sensitivity and/or specificity based on demand (via ROC curve)
- No need for extraction of sample
- Easy assessment method
- Simultaneous detection of several viruses
- Detection of ill people in the silent stage of the disease
- Detection of both animal and human viruses
- Rapid calibration of device on either newly generated or mutated viruses

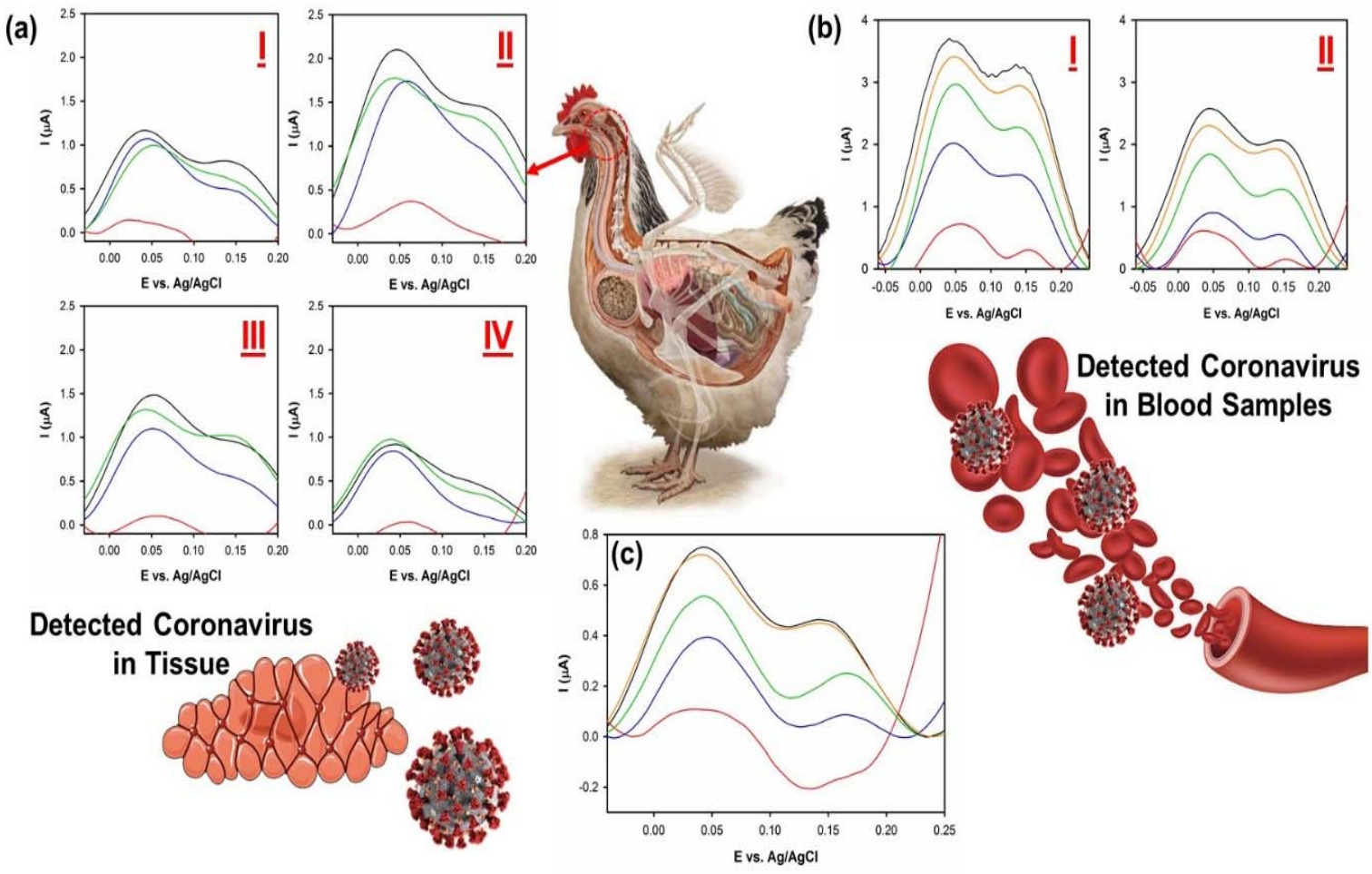
Food Safety

Animal Viruses



(a) (I) DPV analysis of gammacoronavirus (i.e., Infectious bronchitis viruses (IBV)) in PBS (pH=7.4), (II) DPV analysis of bronchitis viruses' S-spike in PBS with pH 7.4 and (III) DPV analysis of bronchitis viruses' S-spike in human plasma; (b) DPV analysis of Avian influenza in PBS with pH=7.4; (c) Newcastle disease virus (I) LaSota strain and (II) V4 strain in PBS with pH=7.4.

Food Safety Real Animal Samples



Detection of wild version of IBV from (a) oropharyngeal swab, (b) blood and (c) tracheal mucosa layer of infected chickens.

Thank you for Listening!

Xegate S.A.
Via Vincenzo Vela, 8
6600 Locarno – Switzerland

Tel: +41 91 228 0398
E-mail: info@xegate.eu
Website: www.xegate.eu