Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary data

A novel portable immuno-device for the recognition of Lymphatic vessel endothelial hyaluronan receptor-1 biomarker using GQD-AgNPrs conductive ink stabilized on the surface of cellulose

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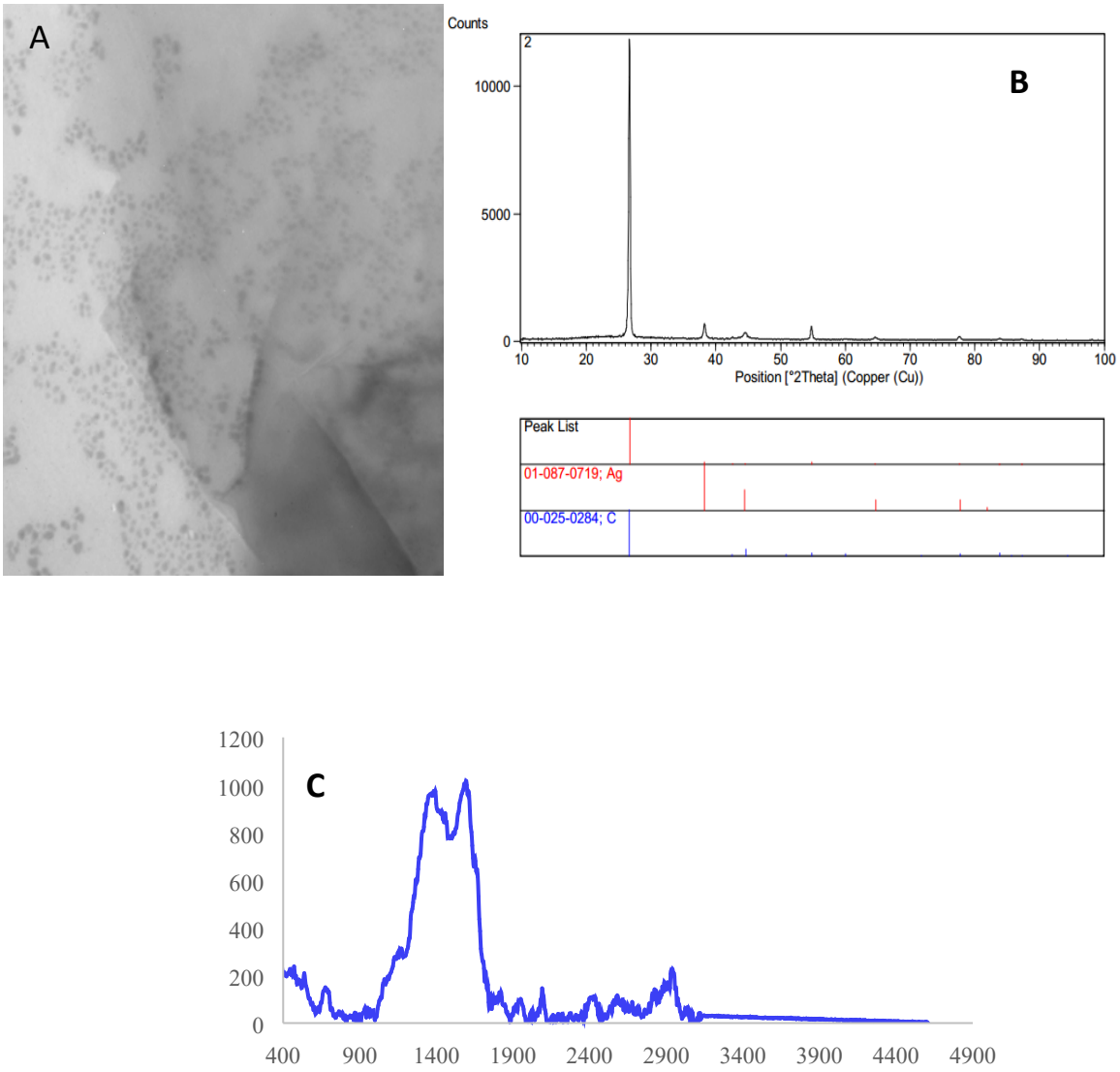
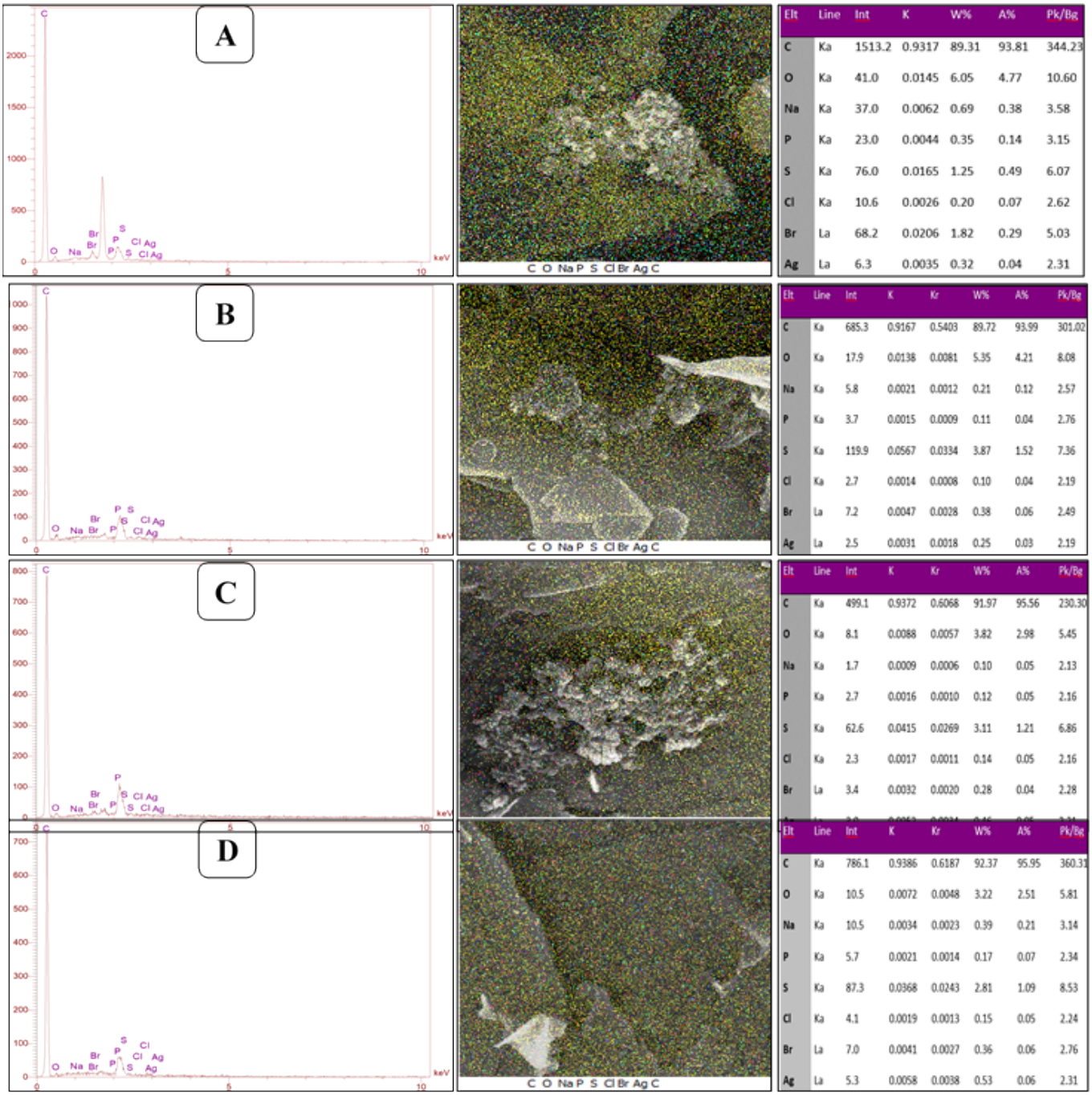


Fig. S1: A) TEM images of Ag/GQDs nano-ink in different magnification. **B and C)** XRD and Raman Spectra of Ag/GQDs nano-ink.



Elt	Line	Int	K	W%	A%	Pk/Bg
C	Ka	1513.2	0.9317	89.31	93.81	344.23
O	Ka	41.0	0.0145	6.05	4.77	10.60
Na	Ka	37.0	0.0062	0.69	0.38	3.58
P	Ka	23.0	0.0044	0.35	0.14	3.15
S	Ka	76.0	0.0165	1.25	0.49	6.07
Cl	Ka	10.6	0.0026	0.20	0.07	2.62
Br	La	68.2	0.0206	1.82	0.29	5.03
Ag	La	6.3	0.0035	0.32	0.04	2.31

Elt	Line	Int	K	Kr	W%	A%	Pk/Bg
C	Ka	685.3	0.9167	0.5403	89.72	93.99	301.02
O	Ka	17.9	0.0138	0.0081	5.35	4.21	8.08
Na	Ka	5.8	0.0021	0.0012	0.21	0.12	2.57
P	Ka	3.7	0.0015	0.0009	0.11	0.04	2.76
S	Ka	119.9	0.0567	0.0334	3.87	1.52	7.36
Cl	Ka	2.7	0.0014	0.0008	0.10	0.04	2.19
Br	La	7.2	0.0047	0.0028	0.38	0.06	2.49
Ag	La	2.5	0.0031	0.0018	0.25	0.03	2.19

Elt	Line	Int	K	Kr	W%	A%	Pk/Bg
C	Ka	499.1	0.9372	0.6068	91.97	95.56	230.30
O	Ka	8.1	0.0088	0.0057	3.82	2.98	5.45
Na	Ka	1.7	0.0009	0.0006	0.10	0.05	2.13
P	Ka	2.7	0.0016	0.0010	0.12	0.05	2.16
S	Ka	62.6	0.0415	0.0269	3.11	1.21	6.86
Cl	Ka	2.3	0.0017	0.0011	0.14	0.05	2.16
Br	La	3.4	0.0032	0.0020	0.28	0.04	2.28

Elt	Line	Int	K	Kr	W%	A%	Pk/Bg
C	Ka	786.1	0.9386	0.6187	92.37	95.95	360.31
O	Ka	10.5	0.0072	0.0048	3.22	2.51	5.81
Na	Ka	10.5	0.0034	0.0023	0.39	0.21	3.14
P	Ka	5.7	0.0021	0.0014	0.17	0.07	2.34
S	Ka	87.3	0.0368	0.0243	2.81	1.09	8.53
Cl	Ka	4.1	0.0019	0.0013	0.15	0.05	2.24
Br	La	7.0	0.0041	0.0027	0.36	0.06	2.76
Ag	La	5.3	0.0058	0.0038	0.53	0.06	2.31

Fig.S2. EDS and map-analysis of **(A)** AgNPrs-GQD nano-ink **(B)** AgNPrs-GQD nano-ink-Ab, and **(C)** AgNPrs-GQD nano-ink -Ab-BSA, **D)** AgNPrs-GQD nano-ink -Ab-BSA-Ag.

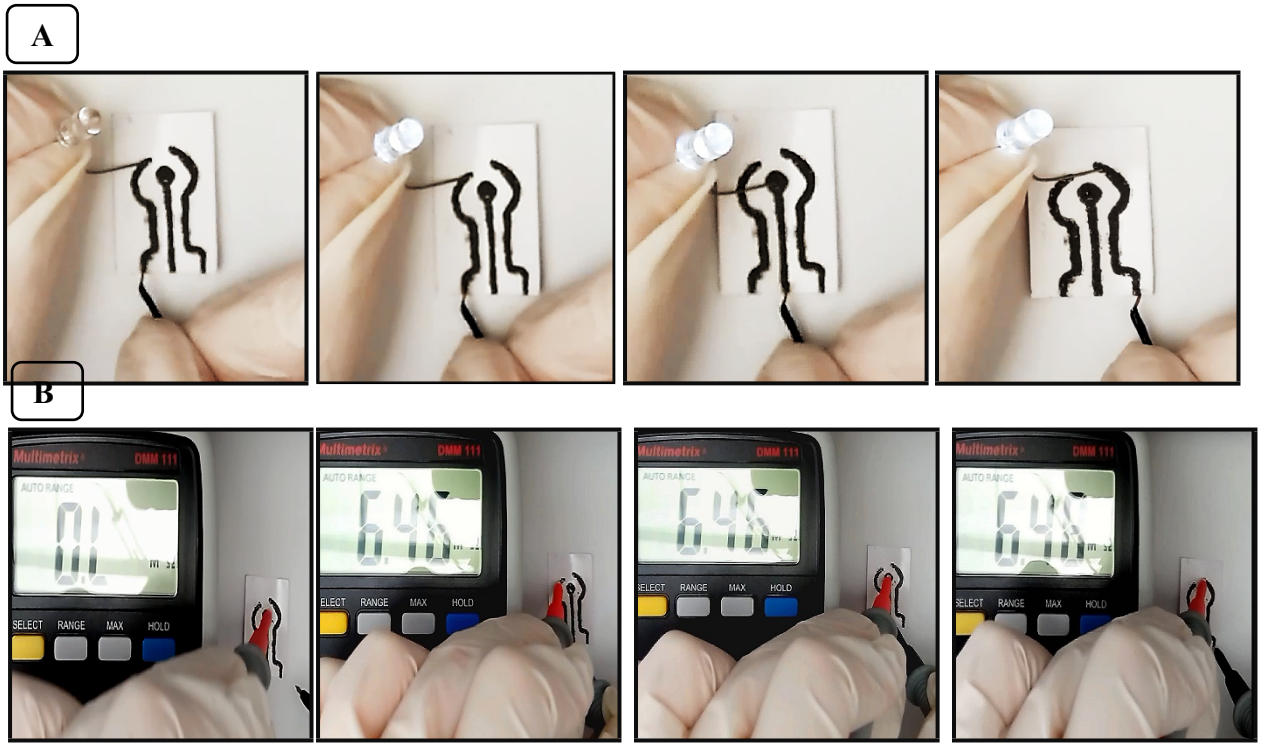


Fig.S3. Photographic images of diverse conductive tracks drawn using AgNPrs-GQDs nano-ink**. A)** Establishing electrical connections between 3-volt battery and a LED lamp connected to designated surface coated with AgNPrs-GQD nano-ink**. B)** Examining the resistance of a photographic paper surface coated with AgNPrs-GQD nano-ink**.**

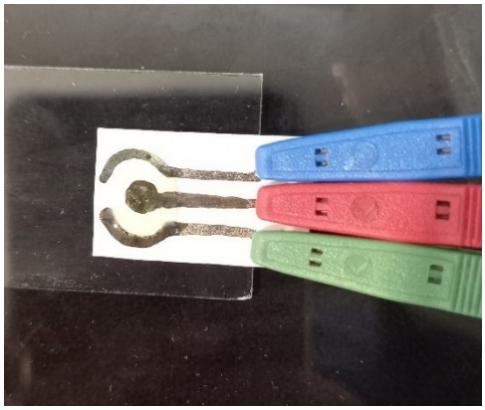


Fig. S4. Photographic image of three electrodes paper-based sensor prepared by direct writing of conductive nano-ink.

Fig. S5. A) DPV's of three similar types of immunosensor prepared in the same condition. **B)** Histograms of peak current *versus* types/number of biosensor. Supporting electrolyte is $K_4Fe(CN)_6/K_3Fe(CN)_6/KCl$.

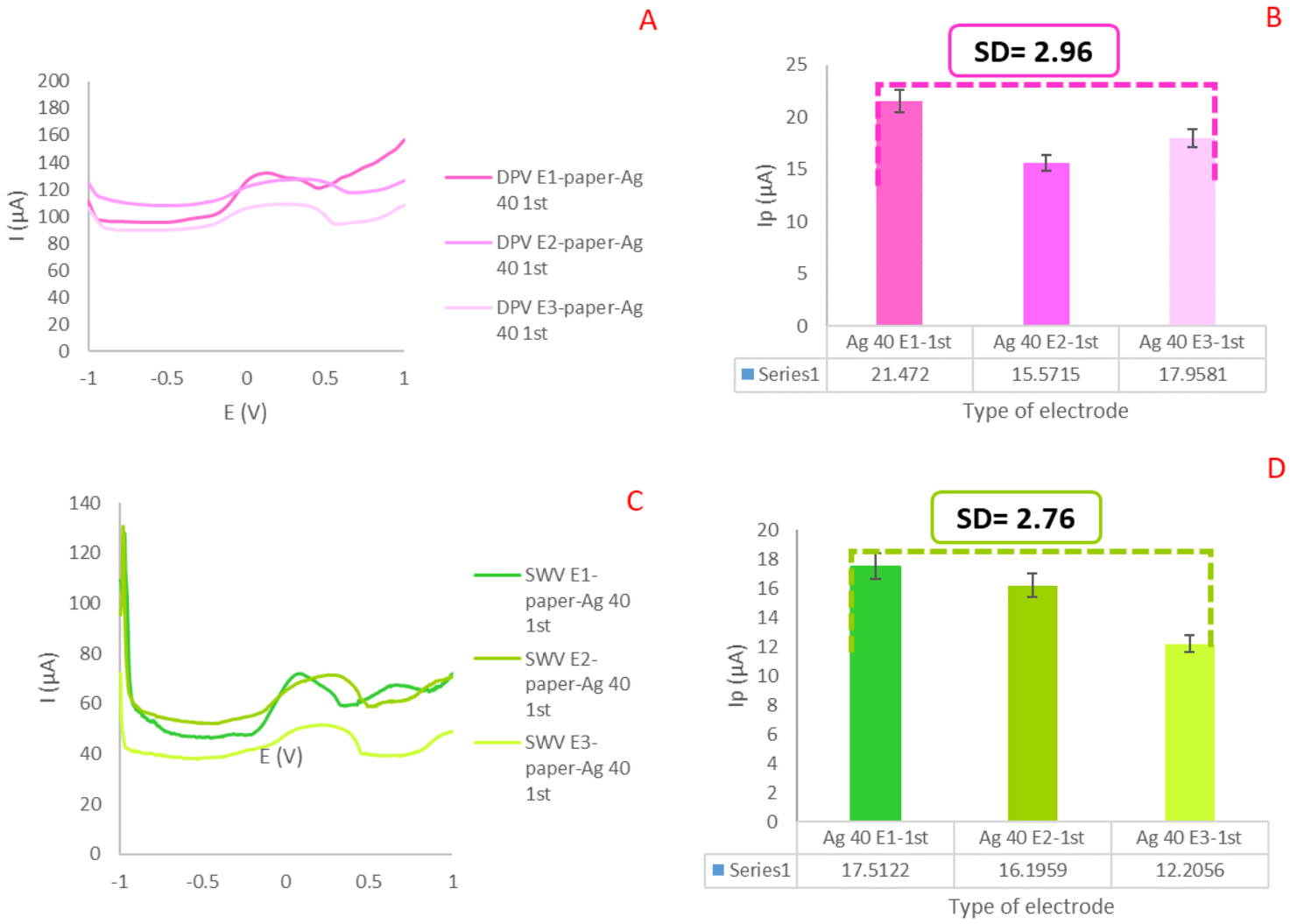


Fig. S6. A) SWV's of three types of immunosensor in the presence of some concentrations of LYVE-1 (40 pg.ml) for inter-electrode reproducibility test. **B)** Histograms of peak current versus the types/number of biosensor. Supporting electrolyte was $K_4Fe(CN)_6/K_3Fe(CN)_6/KCl$.

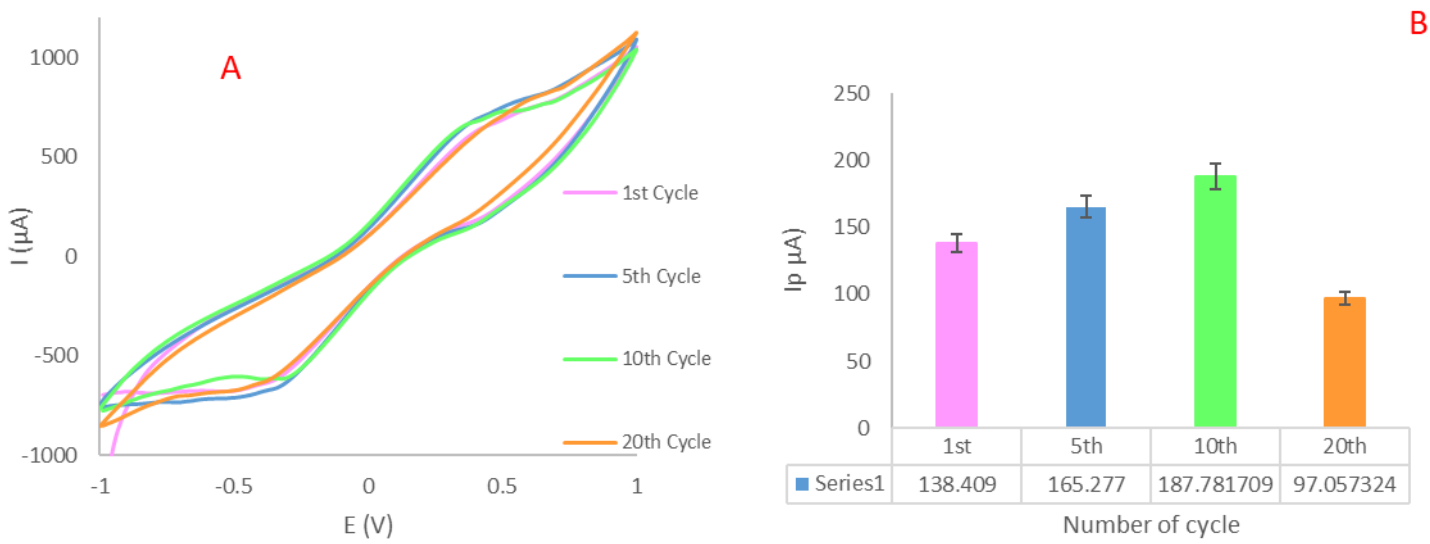


Fig.S7. A) CVs of AgNPrs/GQD nano-ink stabilized on the surface of paper in different cycles (1st, 5th, 10th and 20th cycles). **B)** Histograms of peak current *versus* number of cycles.

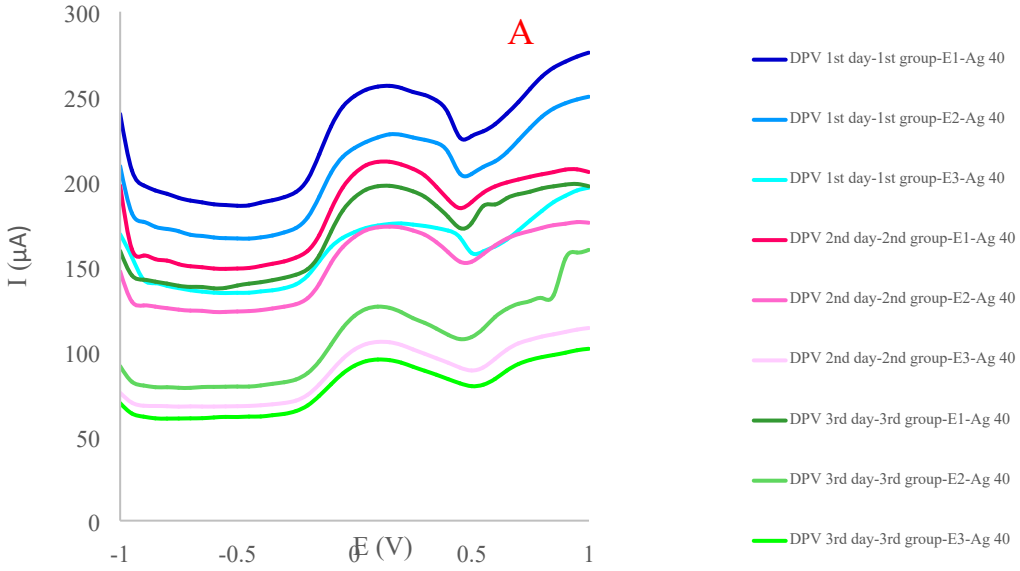
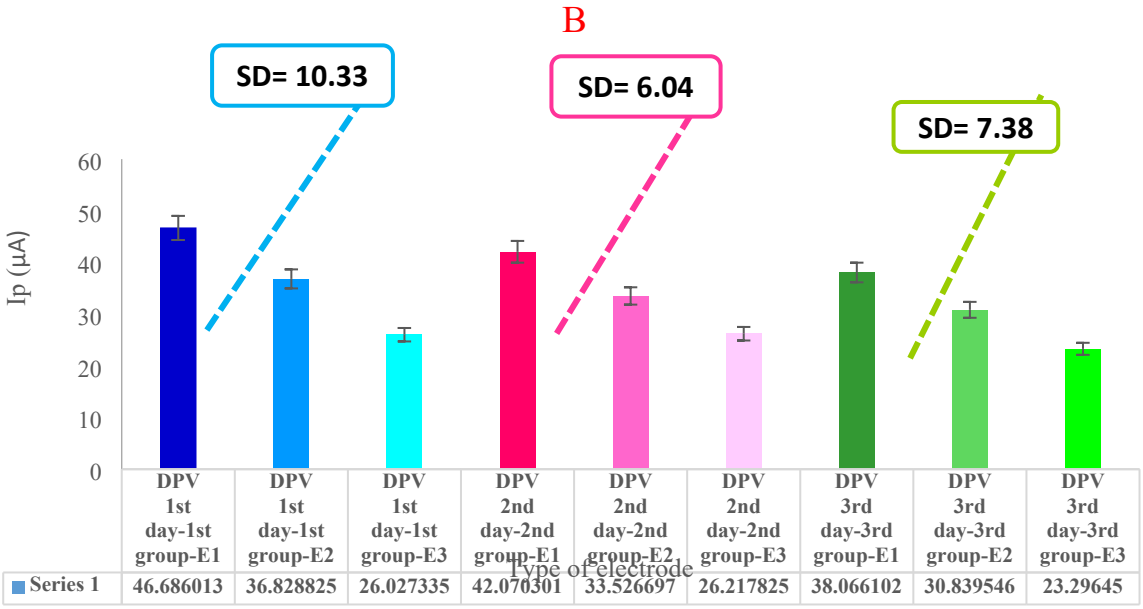


Fig.S8. A) DPV's of AgNPrs-GQDs nano ink/ Biotin-Ab/BSA/Ag (20 pg.ml) modified paper-based three



electrodes with same concentration of Ag for study of repeatability in three days. **B)** Histograms of peak current versus the types of modified electrodes. Supporting electrolyte was $K_4Fe(CN)_6/K_3Fe(CN)_6/KCl$. (RSD for E_1= 0.28, E_2= 0.178, E_3= 0.2).

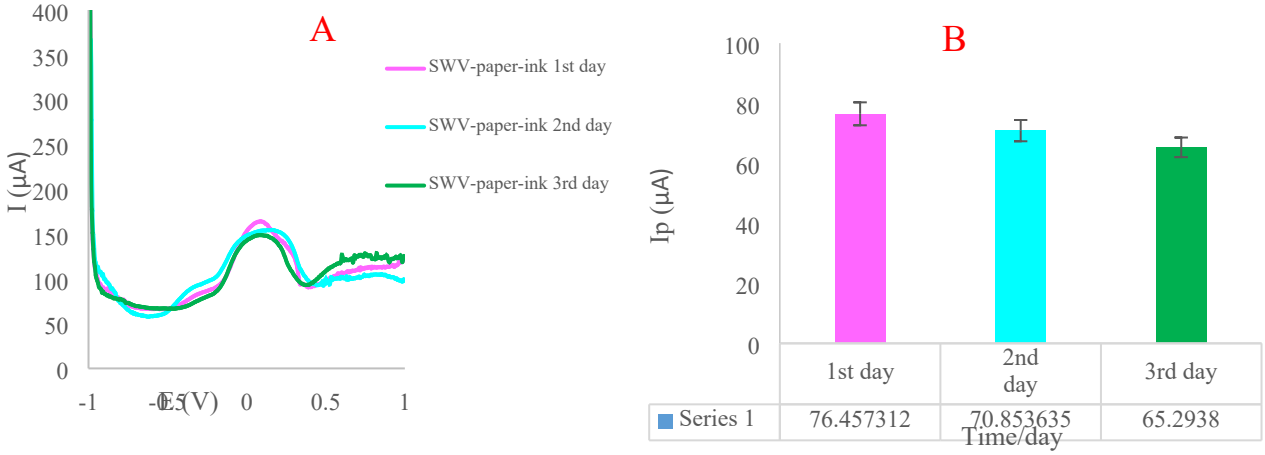


Fig.S9. A) SWVs of AgNPrs-GQDs modified photographic paper for investigation of inter-day stability of immunosensor substrate, in three days. **B)** Histograms of peak current *versus* three days of incubation.

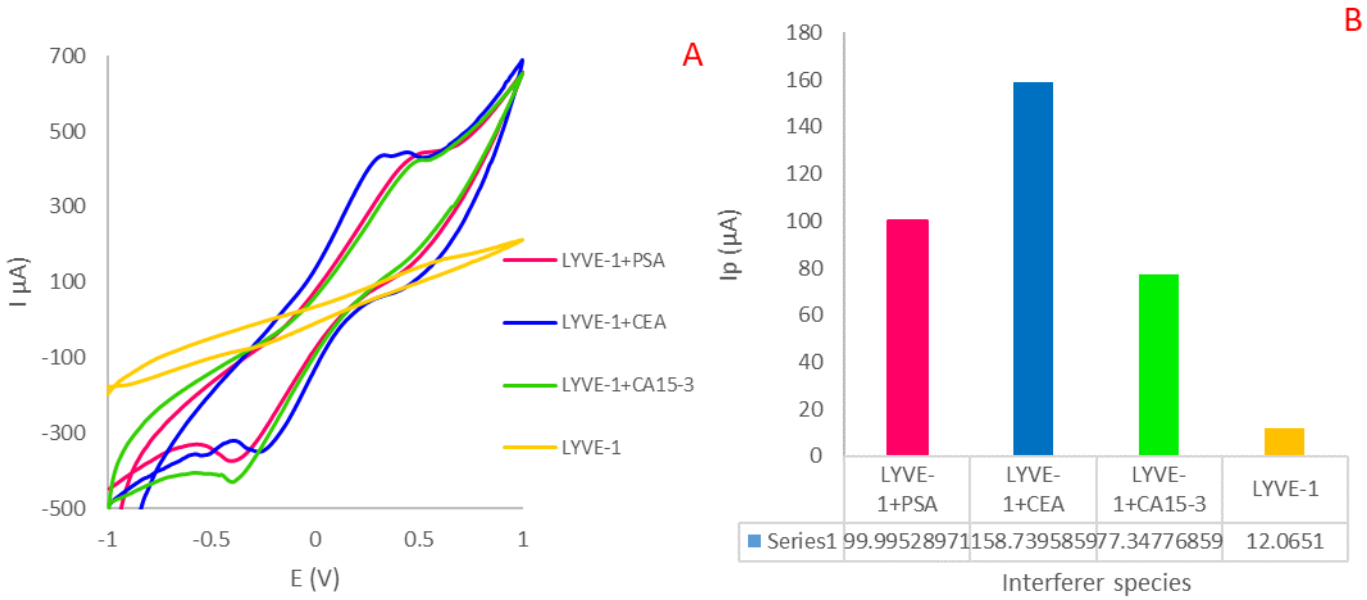


Fig.S10. A) CVs of immunosensor tested for the detection of LYVE-1, in the presence of interferer species (PSA, CEA, CA15-3). **B)** Histograms of peak current *versus* type interferer species.