Supporting Information

Electropolymerization of chitosan in the presence of CuNPs on the surface of copper electrode: An advanced nanocomposite for determination of mefenamic acid and indomethacin in human plasma samples and prevention of drug poisonings

Fatemeh Farshchi [a], Mohammad Hasanzadeh [b*], Mahsa Feyziazar [c], Arezoo Saadati [d], Soodabeh Hassanpour [e]

[a] Biotechnology Research Center, Tabriz University of Medical Sciences, Tabriz, Iran.

[b] Pharmaceutical Analysis Research Center, Tabriz University of Medical Sciences, Tabriz, Iran.

[c] Liver and Gastrointestinal Diseases Research Center, Tabriz University of Medical Sciences, Tabriz, Iran.

[d] Nutrition Research Center, Tabriz University of Medical Sciences, Tabriz, Iran.

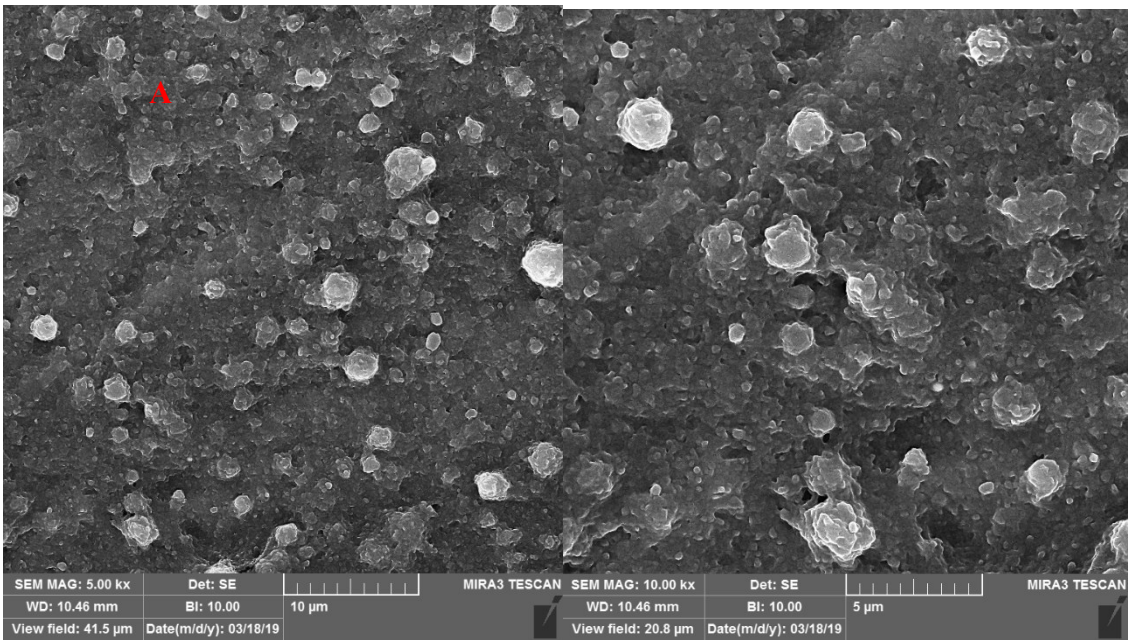
[e] Department of Analytical Chemistry, Faculty of Science, Palacky University Olomouc, 17. listopadu 12, 77146 Olomouc, Czech Republic.

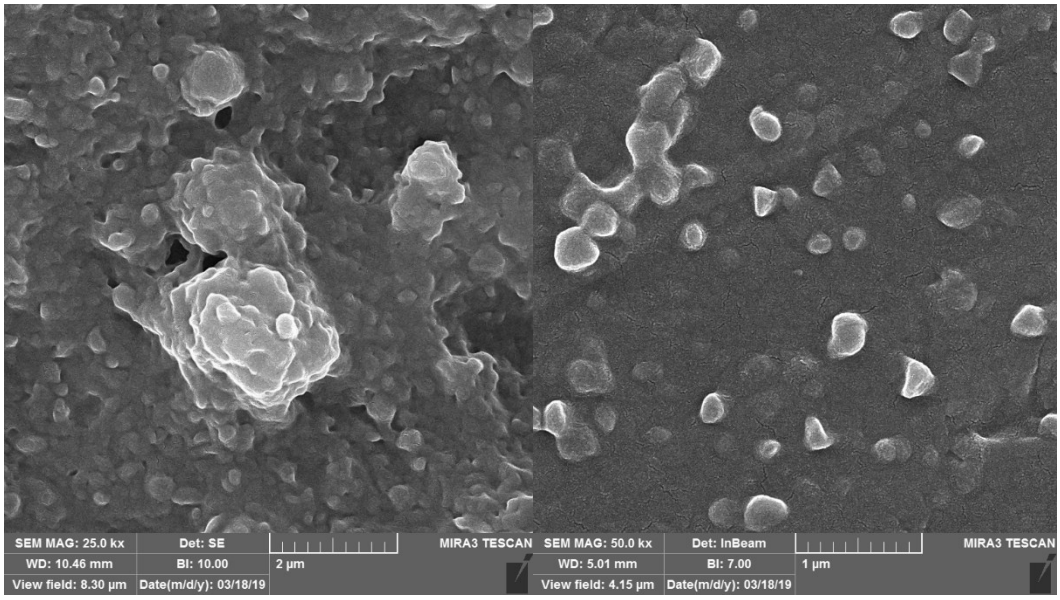
Corresponding Author
E-mail address: (*) hasanzadehm@tbzmed.ac.ir, mhmmd_hasanzadeh@yahoo.com
Tabriz University of Medical Sciences, Tabriz 51664, Iran.
Tel: +98(41) 33363311; Fax: +98(41)33363231

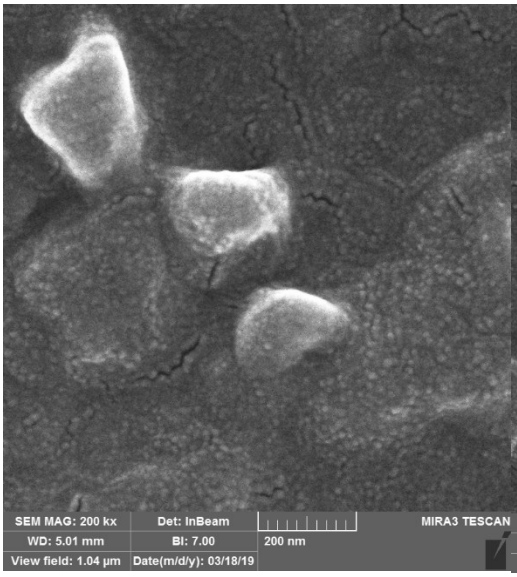
Characterizations

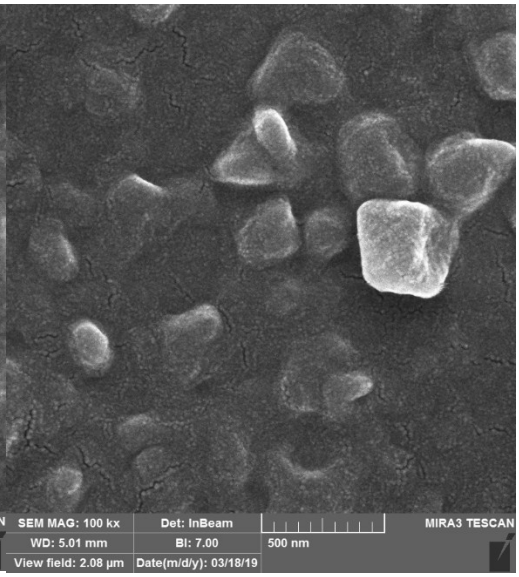
The TEM, FE-SEM, and EDS of Cu nanocubes

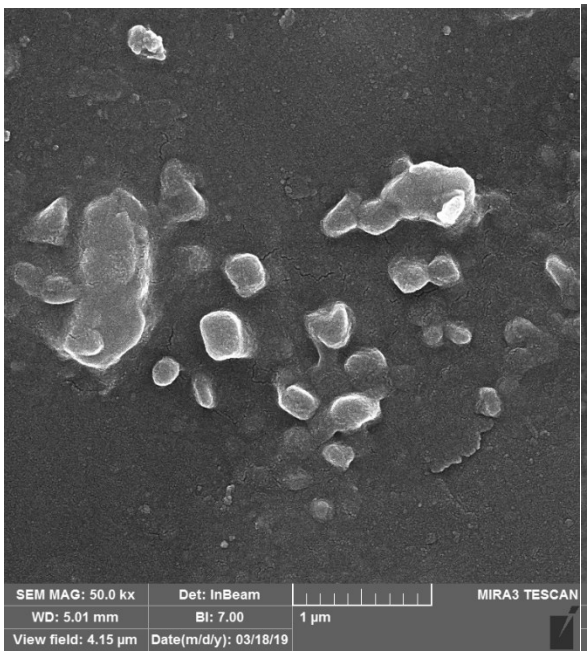
To investigate the mechanism of copper nanoparicles formation and surface morphology, FE-SEM and TEM images were recorded in Fig. S1. FE-SEM images revealed that PCS with amine group bind to Cu and beautiful cubes formed. Likewise, reasonably distributed particles can be seen from the TEM picture shown in Fig. S1.

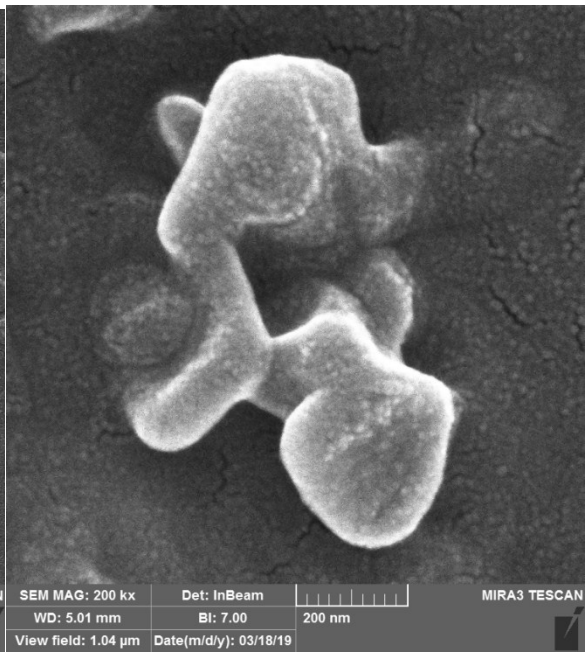


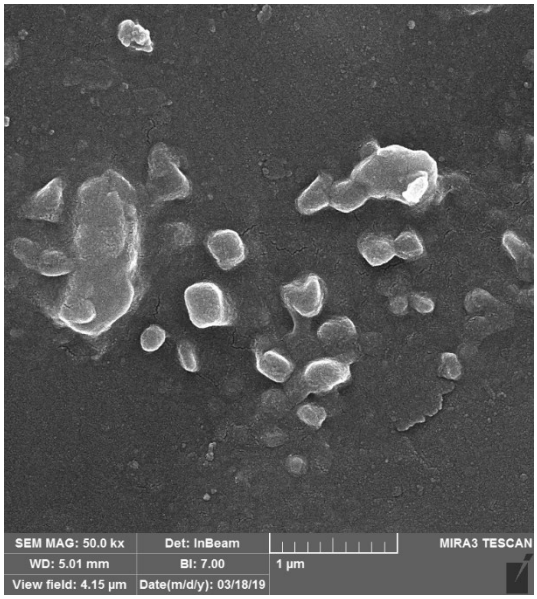


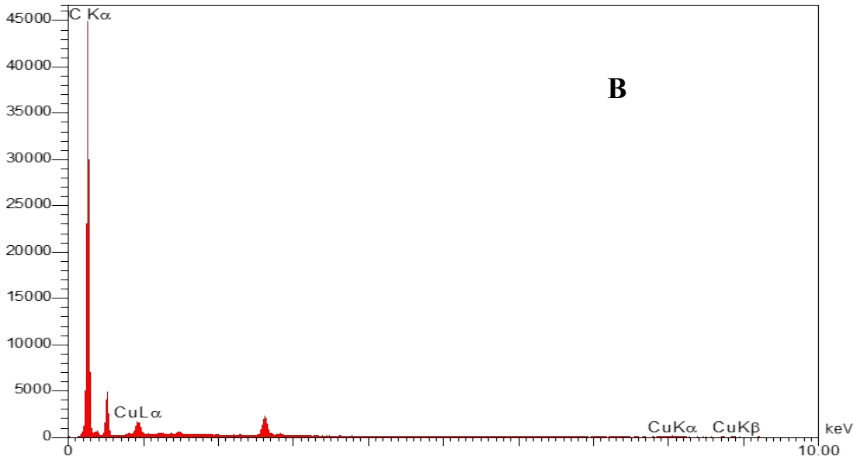

SEM MAG: 200 kx
Det: InBeam
MIRA3 TESCAN
WD: 5.01 mm
BI: 7.00
200 nm
View field: 1.04 µm
Date(m/d/y): 03/18/19


SEM MAG: 100 kx
Det: InBeam
MIRA3 TESCAN
WD: 5.01 mm
BI: 7.00
500 nm
View field: 2.08 µm
Date(m/d/y): 03/18/19


SEM MAG: 50.0 kx
Det: InBeam
MIRA3 TESCAN
WD: 5.01 mm
BI: 7.00
1 µm
View field: 4.15 µm
Date(m/d/y): 03/18/19


SEM MAG: 200 kx
Det: InBeam
MIRA3 TESCAN
WD: 5.01 mm
BI: 7.00
200 nm
View field: 1.04 µm
Date(m/d/y): 03/18/19





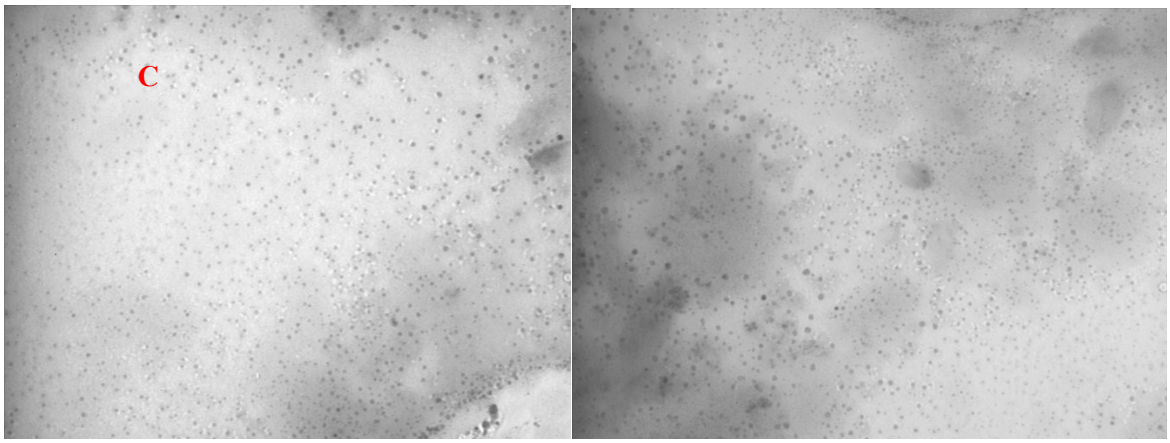


Fig.S1: (A) FE-SEM, (B) EDS and (C) TEM images of copper nanoparticles.

Characterization of modified electrodes morphology

To investigate the presence of the copper nanoparticles and poly-chitosan modified copper nanoparticle on the surface of copper electrode, field emission scanning electron microscope images recovered. The FE-SEM images of copper nanoparticles electrode and poly chitosan modified copper nanoparticles are presented in Figs. S2 & S3.

The copper nanoparticles are closely spaced and make a regular matrix (Fig. S3). Also, poly-chitosan formed a regular polymer film. These results confirmed that copper electrode was successfully coated by and poly chitosan modified copper nanoparticles film leading to a change in the level of electrode activity (Fig.4). All of these results were confirmed by EDS.

The EDS showed high concentration of copper on the and poly chitosan modified copper nanoparticles modified copper electrode. In addition to this, the concentration of carbon was also high on the and poly chitosan modified copper nanoparticles. The reason for such higher concentration is associated to the present of chitosan.

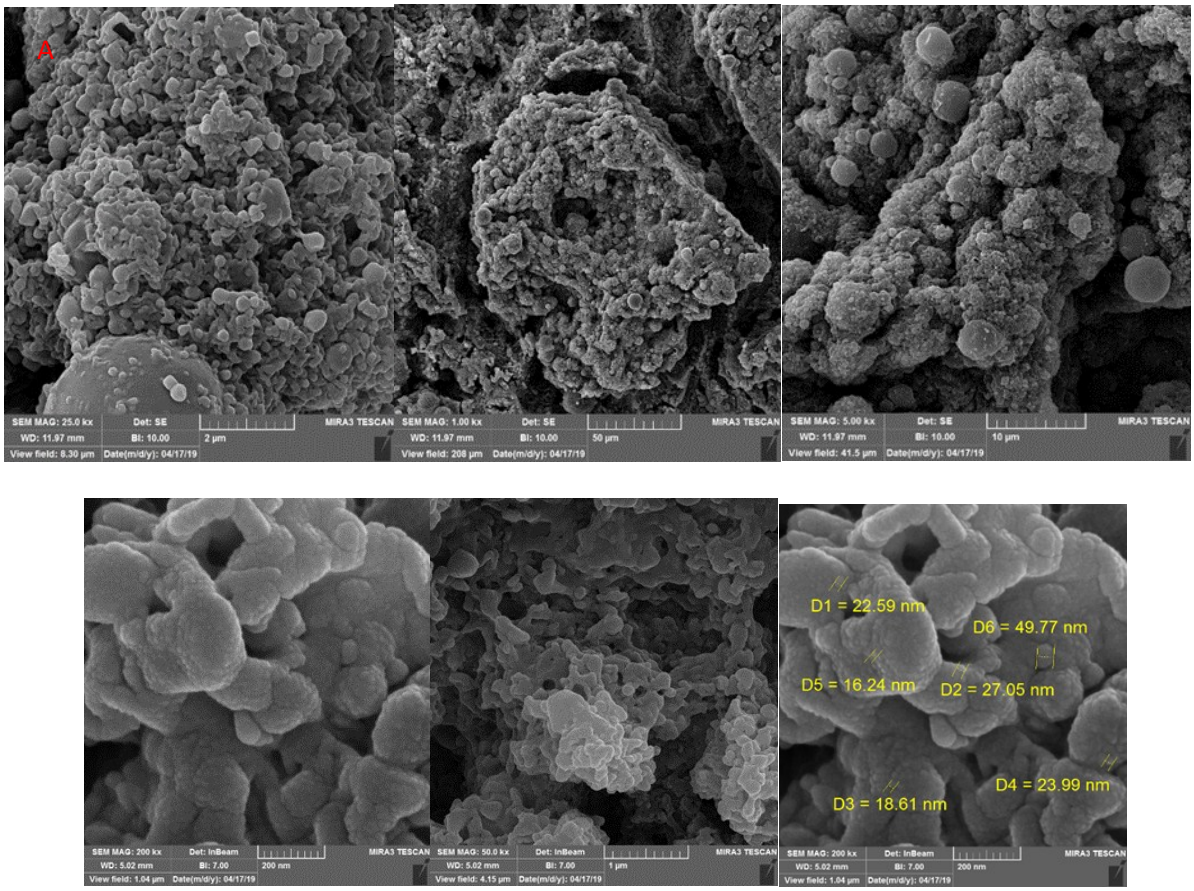
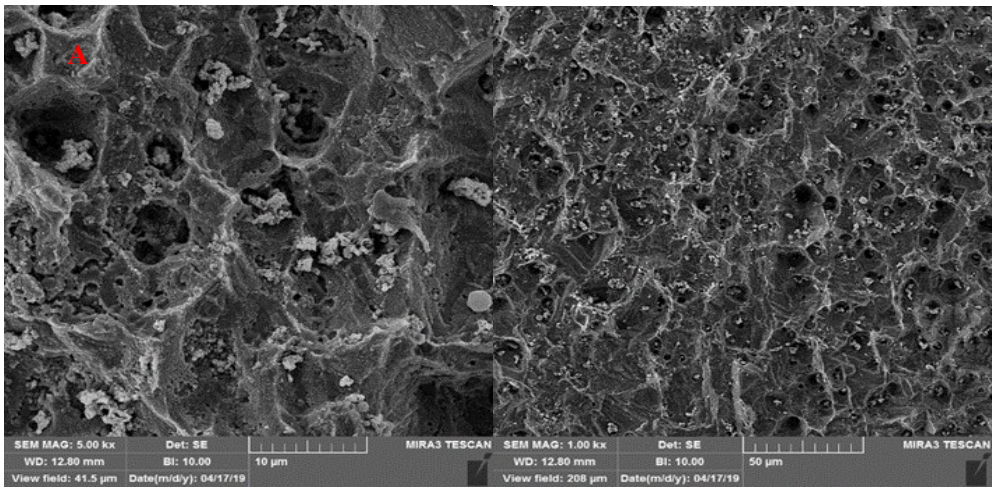
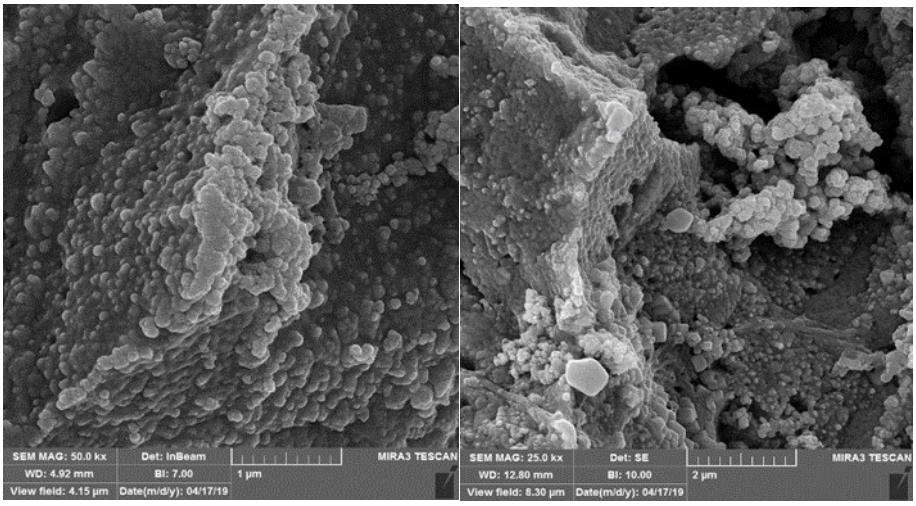
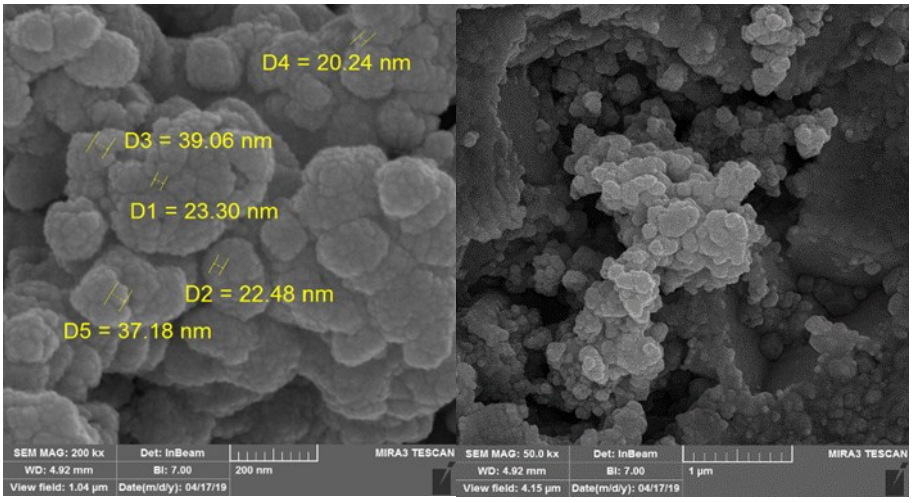


Fig . S2. (A & B) FE-SEM images and EDS of the CuNPs on Cu electrode.


A
SEM MAG: 5.00 kx
Det: SE
MIRA3 TESCAN
WD: 12.80 mm
BI: 10.00
10 µm
View field: 41.5 µm
Date(m/d/y): 04/17/19
SEM MAG: 1.00 kx
Det: SE
MIRA3 TESCAN
WD: 12.80 mm
BI: 10.00
50 µm
View field: 208 µm
Date(m/d/y): 04/17/19


SEM MAG: 50.0 kx
Det: InBeam
MIRA3 TESCAN
WD: 4.92 mm
BI: 7.00
1 µm
View field: 4.15 µm
Date(m/d/y): 04/17/19
SEM MAG: 25.0 kx
Det: SE
MIRA3 TESCAN
WD: 12.80 mm
BI: 10.00
2 µm
View field: 8.30 µm
Date(m/d/y): 04/17/19


D4 = 20.24 nm
D3 = 39.06 nm
D1 = 23.30 nm
D2 = 22.48 nm
D5 = 37.18 nm
SEM MAG: 200 kx
Det: InBeam
MIRA3 TESCAN
WD: 4.92 mm
BI: 7.00
200 nm
View field: 1.04 µm
Date(m/d/y): 04/17/19
SEM MAG: 50.0 kx
Det: InBeam
MIRA3 TESCAN
WD: 4.92 mm
BI: 7.00
1 µm
View field: 4.15 µm
Date(m/d/y): 04/17/19

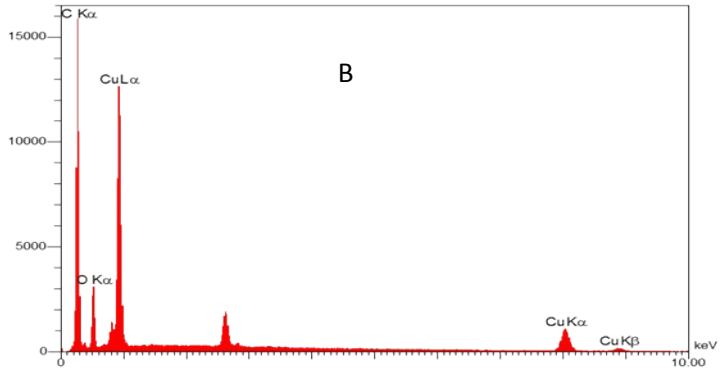


Fig. S3. (A & B) FE-SEM images and EDS of PCS-CuNPs modified CuE.

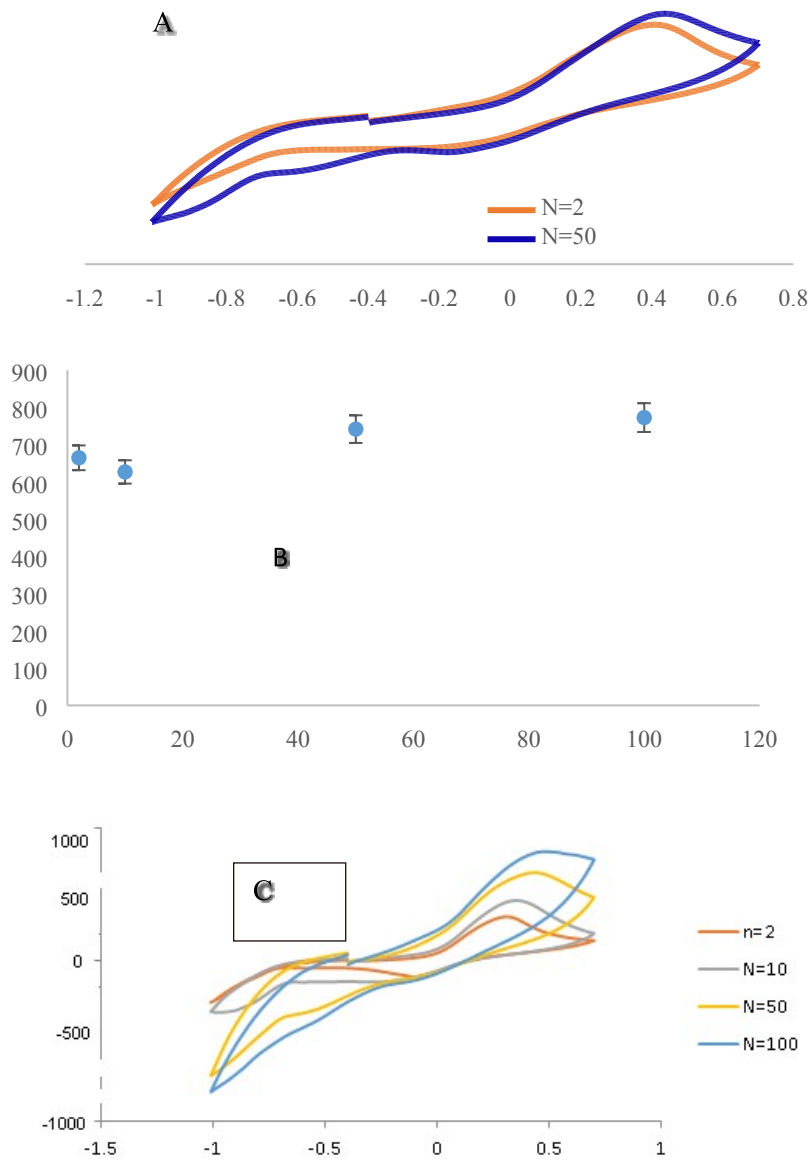


Fig. S4. *A) CV of PCS-CuNCs/CuE in different cycle numbers in 1Mm of* $Fe(CN)_6^{3-/4-}$ ***(B)*** *Related histogram. C) CV of CuNCs/CuE in different cycle numbers in 1Mm* $Fe(CN)_6^{3-/4-}$.

Table S1: Analttical parameters for determination of IND and MEF.

Analytical parameters	MEF	IND
Linear range (µM)	0.004-10000	0.001-10000
RSD (%)	2.89	3.27
LLOD (µmol.L^{-1})	0.001	0.001
Slope (M)	-17.679	-7.3167
R^2	0.9439	0.9502

Table S2. Copartion of the analytical results for determination of IND and MEF using different methods

DRUG	METHOD	LINEARRANGE	LOD	REF
IND	LSV DPV	10µM-30 Mm 85 n M-15µM	1.5µM 50n M	1
	Colorimetric	3.3-11µ gm/L	0.90µg/L	2
	DPV	-	3.21µM	3
	Micellarelectrokinetic chromatography with UV detection	0.3-10.0µg/mL	0.1µg/mL	4
	HPLC with *in situ* electrogenerated Mn(III)chemiluminescence's detection	0.01-10µgmL	8ng/mL	5
	HPLCwith column switching	50-10000ng/mL	50ng/mL	6
	Sequential injection analysis	0.56.-5 ng/mL	0.15ng/mL	7
	Moleculeimprinting-chemiluminescence	0.1-10 ng/mL	4ng/mL	8
MEF	Atomic absorption	30–241 µg/mL	5 µg/mL	9
	CV	20–4000 nM	6.0 pM	10
	Flowinjection analysis	0.05–6.0 mg/mL	0.21 µM	11
	spectrophotometric (ratiospectra derivative spectrophotometry)	2–10 µg/mL	1.15 µg/mL	12
	Potentiometricm	10mM-1.0µ M	0.62 µM	13
	Liquid chromatography	25–2000 ng/mL	25 ng/mL	14
MEF IND	DPV/ Electrochemical	0.02-150µM 0.08-435µM	0.02µM 0.08µM	15
IND MEF	DPV/ Electrochemical	10 mM to 1nM 10 mM to 4nM	0.001µM 0.004µM	Present study

Referencess

1. J. Xu, F. Shang, J. H. Luong, K. M. Razeeb and J. D. Glennon, *Biosensors & bioelectronics*, 2010, **25**, 1313-1318.
2. H. Hassan, A. Kashyout, I. Morsi, A. Nasser and H. Abuklil, *Sensing and bio-sensing research* 2015, **5**, 50-54.
3. A. Radi, *Electroanalysis*, 1998, **10**, 103-106.
4. O. A. Adegoke, O. S. Idowu and A. A. Olaniyi, *Acta Pharm*, 2006, **56**, 189-202.
5. C. Reguera, M. Ortiz and M. Arcos, *Electroanalysis*, 2002, **14**, 1699-1706.
6. S. J. Lin, Y. R. Chen, Y. H. Su, H. I. Tseng and S. H. Chen, *Journal of chromatography. B, Analytical technologies in the biomedical and life sciences*, 2006, **830**, 306-313.
7. Y. Zhang, Z. Zhang, G. Qi, Y. Sun, Y. Wei and H. Ma, *Analytica chimica acta*, 2007, **582**, 229-234.
8. S. Liu, M. Kamijo, T. Takayasu and S. Takayama, *Journal of chromatography. B, Analytical technologies in the biomedical and life sciences*, 2002, **767**, 53-60.
9. L. Molina-Garcia, M. L. Fernandez-de Cordova and A. Ruiz-Medina, *Journal of AOAC International*, 2010, **93**, 1443-1449.
10. F. Nie, J. Lu, Y. He and J. Du, *Talanta*, 2005, **66**, 728-733.
11. M. Y. Khuhawar and G. A. Qureshi, *Journal of chromatography. B, Biomedical sciences and applications*, 2001, **764**, 385-407.
12. L. Liu and J. Song, *Analytical biochemistry*, 2006, **354**, 22-27.
13. F. Aly, S. Al-Tamimi and A. Alwarthan, *Analytica chimica acta*, 2000, **416**, 87-96.
14. E. Dinc, C. Yucesoy and F. Onur, *Journal of pharmaceutical and biomedical analysis*, 2002, **28**, 1091-1100.
15. A. Santini, H. Pezza and L. Pezza, *Sensors and Actuators B: Chemical* 2007, **128**, 117-123.