

Electronic supplementary information

Electrode modified with nanoparticles composed of 4,4'-bipyridine-silver coordination polymer for sensitive determination of Hg(II), Cu(II) and Pb(II)

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Table S-1. Electrochemical parameters obtained by fitting EIS data in the successive steps of preparation. (R_s —solution resistance, R_{ct} —charge transfer resistance, Q -constant phase element, W - warburg impedance).

Modification step	R_s (Ω)	R_{ct} ($k\Omega$)	W (μS)	Q ($\mu S/n$)
Bare GCE	106	0.064	295	6.35 / 0.811
PNB/GCE	70.5	7.26	181	3.75 / 0.741
Ag/PMB/GCE	75.4	6.13	282	3.16 / 0.769
Ag-bipy-CP/PMB/GCE	84.3	4.31	251	1.69 / 0.865

GCE- glassy carbon electrode, PMB- phenylmethyl-4,4'-bipyridinium, bipy- 4,4'-bipyridine, CP- coordination polymer

Table S-2. Analytical performance of Ag-bipy-CP/PMB/GCE in comparison with various sensors for Hg (II), Cu (II) and Pb (II) analysis

Modified electrode	Analyte	Peak potential [V]	Linear range [$\mu\text{g L}^{-1}$]	LOD [$\mu\text{g L}^{-1}$]	RSD %	Obs.	Ref.
SPE modified with mercury nano-droplets	Pb (II)	-0.567	8.3 -41.4	4.76	4.5	electrodes can not be reused	[1]
	Cu (II)	-0.270	2.52 -12.6	0.75	3.0		
CPE modified with chitosan nanoparticle-Schiff base	Pb (II)	-0.35	207-20700	149.8	-	interferences from Cu^{2+} , Cd^{2+}	[2]
ITO electrode modified with 5-methyl-2-thiouracil, graphene oxide and gold nanoparticles	Hg (II)	0.74	1 - 22	0.15	3.3	only one analyte	[3]
GCE modified with hierarchical gold dendrites	Cu (II)	0.31	315 - 945	0.63	4.3	was not applied in real samples	[4]
	Pb (II)	-0.09	1035 - 3105	2.07	2.7		
SPE modified with gold films, and metal ion preconcentration with thiol-modified magnetic particles	Hg (II)	0.4	2 - 16	1.5	3	-	[5]
	Pb (II)	-0.28	4-16	0.5	6		
Gold electrode modified with Au nanoparticles	Pb (II)	-0.11	1-100	0.16	4.5	-	[6]
	Cu (II)	0.32		0.15	3.9		
	Hg (II)	0.56		0.14	4.9		
CPE modified with a palladium oxide supported onto natural phosphate	Hg (II)	0.13	50-20000	3.86	4.78	-	[7]
A boron-doped diamond nanocrystalline thin-film	Pb (II)	-0.55	1-10	0.98	3.5	was not applied in real samples	[8]
A hanging mercury drop electrode activate with nano- Al_2O_3	Pb (II)	-0.38	0.01-100	0.0046	2.83	-	[9]
CPE modified with diethylenetriamine pentaacetic acid functionalized Fe_3O_4 magnetic nanoparticles	Cu (II)	-0.1	0.31 - 6350	0.13	5.3	was not applied in real samples	[10]
	Pb (II)	-0.45	103.5 - 207000	1.69	4.9		
GCE modified with nanoparticles composed of Ag-bipy-CP	Hg (II)	+0.3	0.2 - 10	0.09	3.2	-	this work
	Cu (II)	-0.07	1.3 - 6.4	0.71	4.5		
	Pb (II)	-0.54	4.2 - 20.7	2.3	3.9		

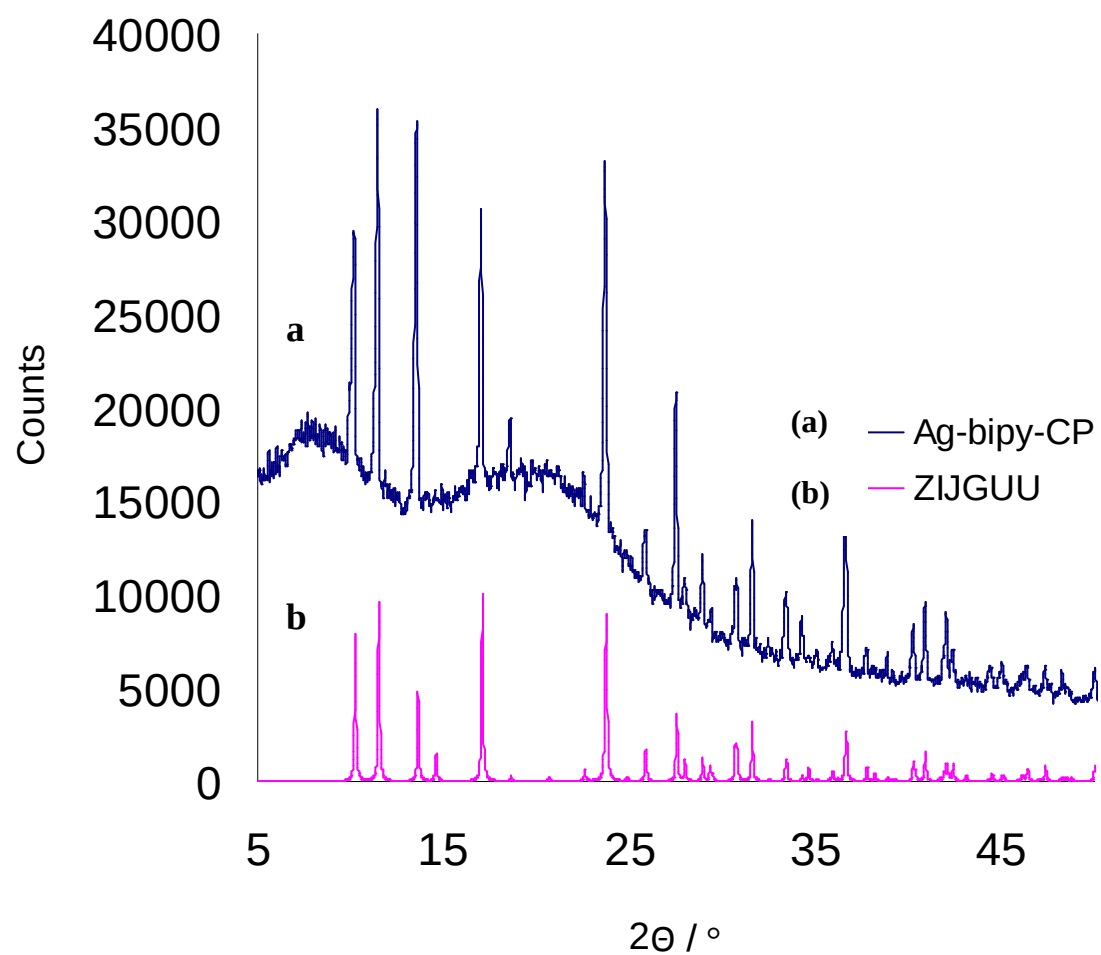


Figure S-1. Comparison of recorded crystal structure analysis for the Ag-bipy-CP (a) and simulated ZIJGUU structure (b)

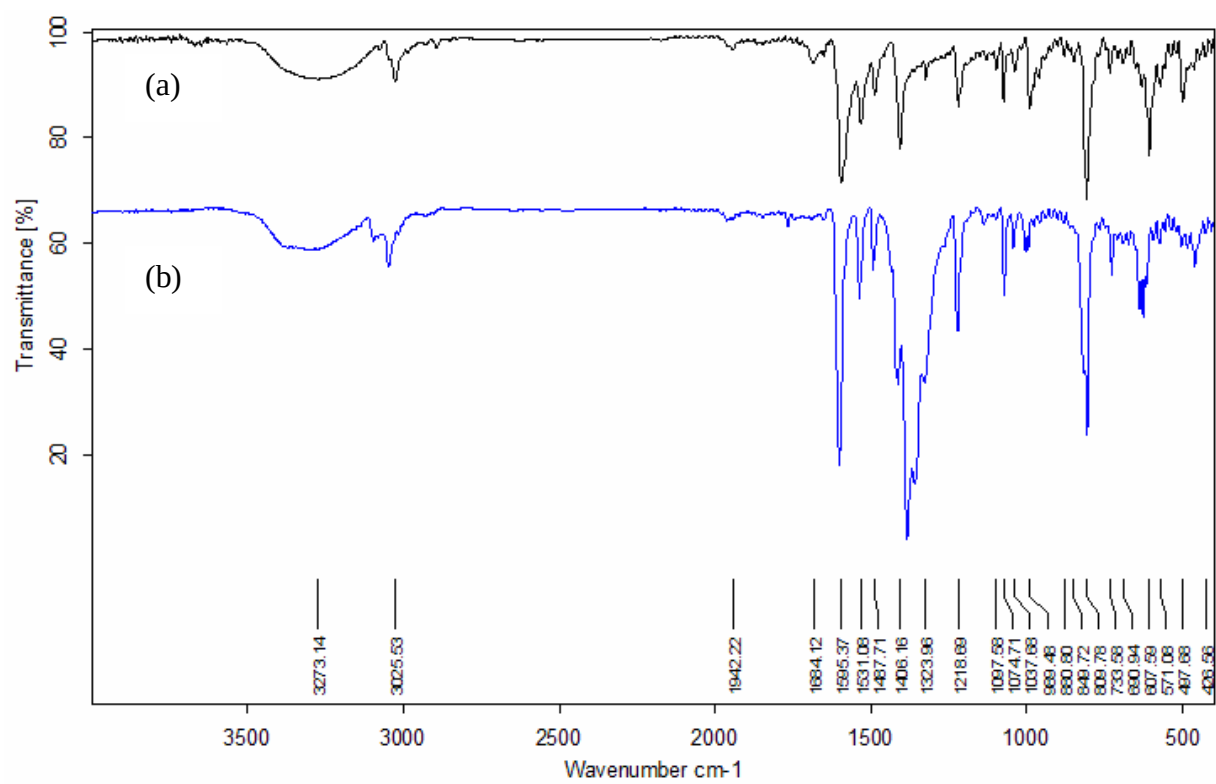


Figure S-2. FT-IR spectra of (a) 4,4'-dipyridine and (b) Ag-dipy-CP

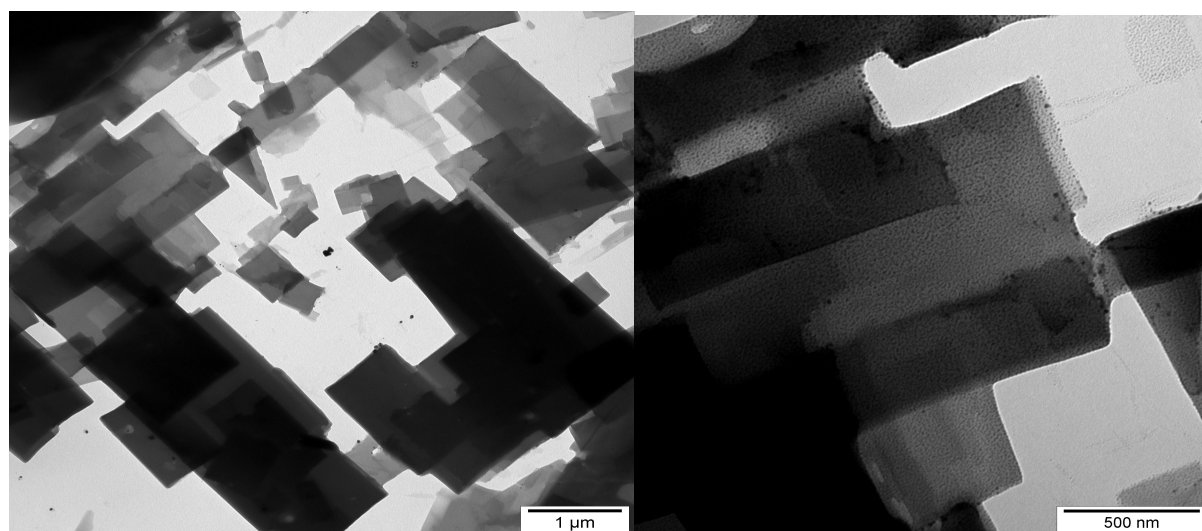


Figure S-3. TEM images of Ag-dipy-CP

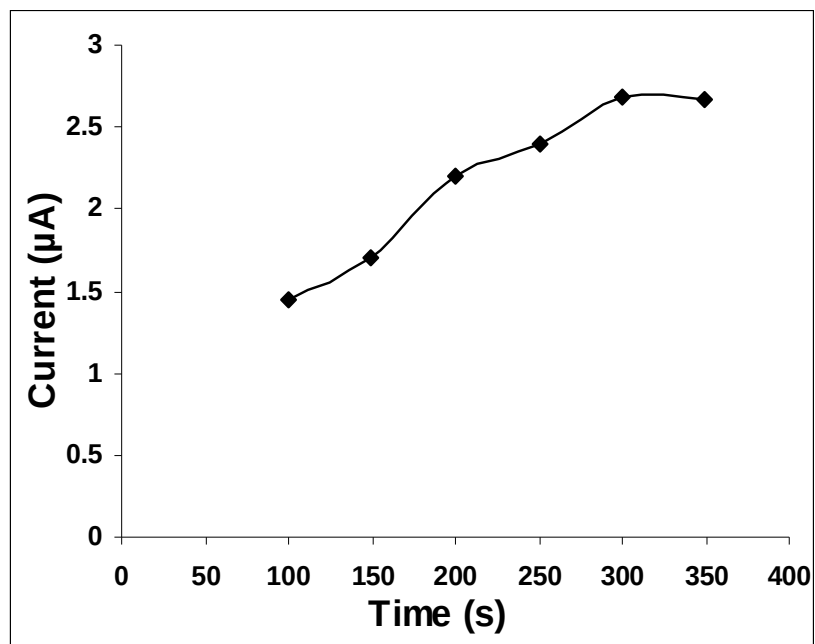


Figure S-4. Response of GCE modified electrode as a function of accumulation time.
Accumulation conditions: $1 \mu\text{g L}^{-1}$ Hg (II) in acetate buffer (pH=5.0) at - 0.6V.

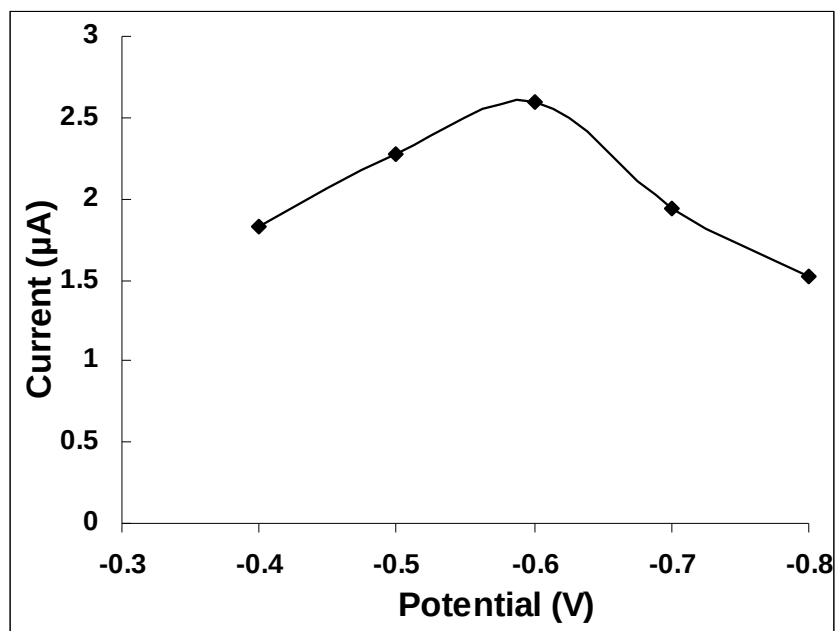


Figure S-5. Influence of the deposition potential on the modified electrode surface to the registered analytical signal of $1 \mu\text{g L}^{-1}$ Hg (II).

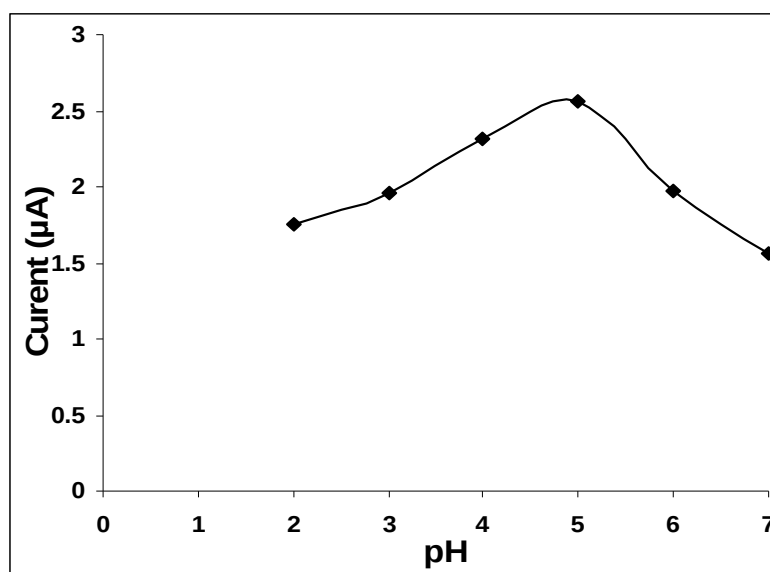


Figure S-6. Effect of the pH on the stripping peak current of $1 \mu\text{g L}^{-1}$ Hg (II) using Ag-bipy-CP/PMB/GCE

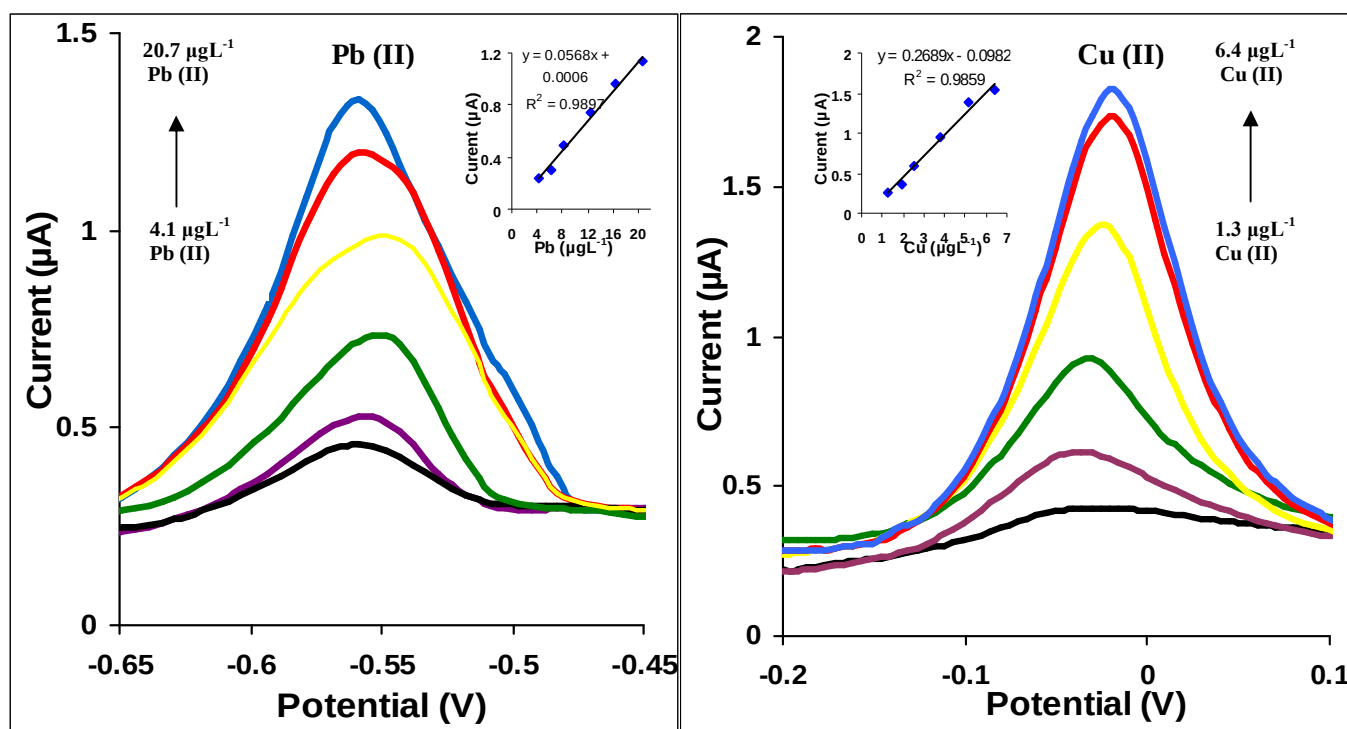


Figure S-7. Differential pulse voltammograms recorded for GC-modified electrode and calibration plots obtained for Pb (II) concentrations: 4.1; 6.2; 8.3; 12.4; 16.5 and $20.7 \mu\text{g L}^{-1}$ and Cu (II) concentrations: 1.3; 1.9; 2.5; 3.8; 5.1 and $6.4 \mu\text{g L}^{-1}$.

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