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Magnetic cobalt ferrite nanoparticles $CoFe_2O_4$ platform as an efficient sensor for trace determination of Cu(II) in water samples and different food products

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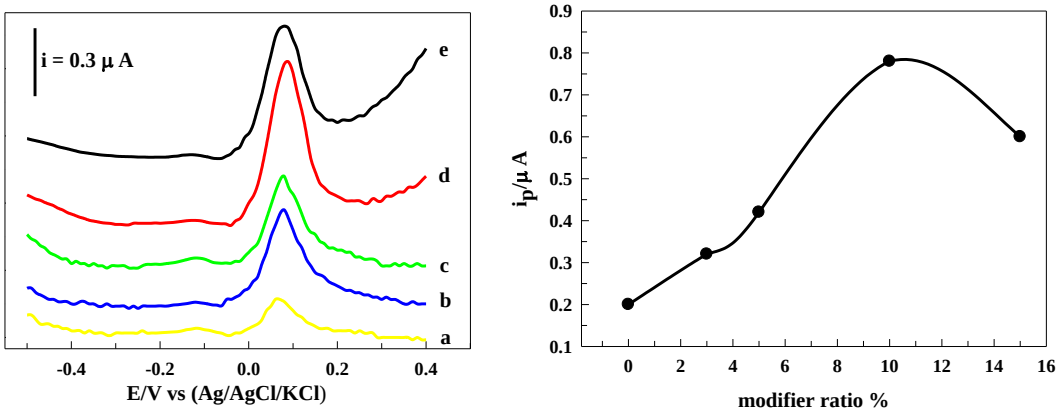

S1. DP-ASV voltammogrames for 50 ppb Cu in the B-R universal buffer solution of pH 4 at E_{acc}= ─0.5 V for 50 s onto $CoFe_2O_4$CPE with various percentages of $CoFe_2O_4$and its corresponding plot, where a) 0 %, b) 3 %, c) 5%, d) 10 %, e) 15 % $CoFe_2O_4$.

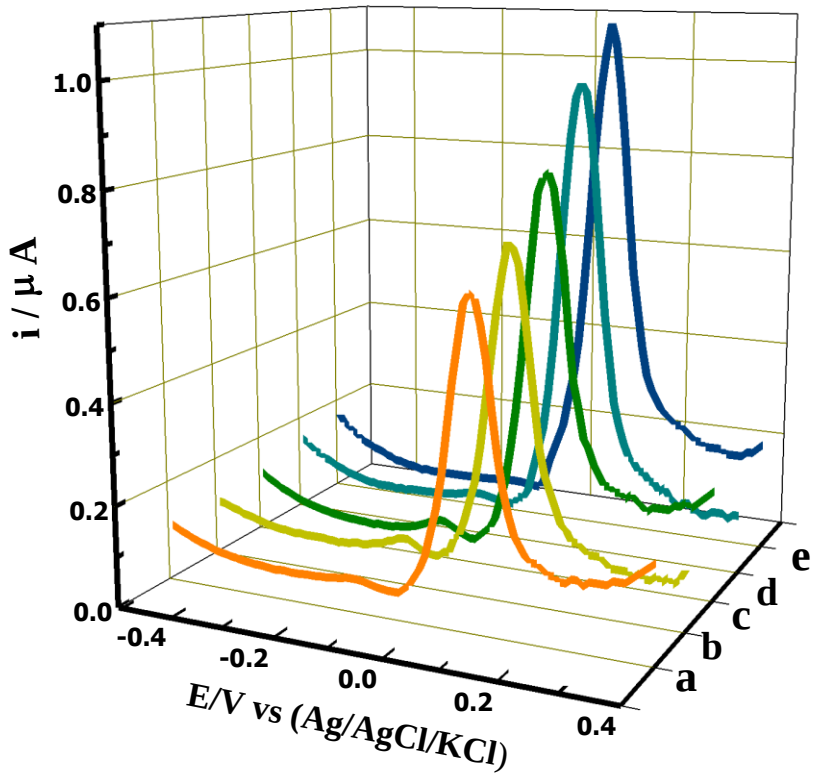

Fig. S2 Voltammogrames for the effect of scan rate on the DP-ASV peak current intensity of 50 ppb Cu(II) in the B-R universal buffer of pH 4 at 10%(w/w) $CoFe_2O_4$/CPE; E_{acc}= ─0.5 V and t_{acc}= 50. a) υ= 20 mV/s, b) υ= 30 mV/s, c) υ= 50 mV/s, d) υ= 66 mV/s and e) υ= 100 mV/s

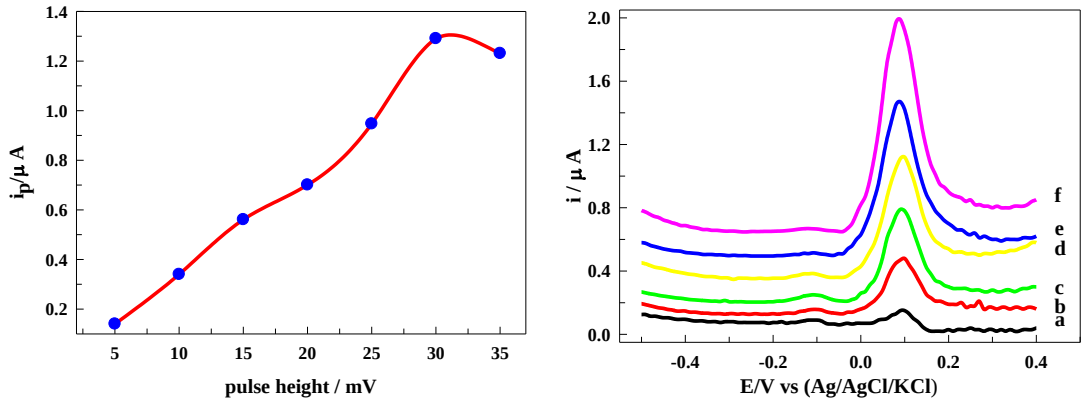

Fig S3. Voltammogrames and its corresponding plots for the effect of pulse height on the DPASV peak current intensity for 50 ppb Cu in the B-R universal buffer solutions of pH=4 at t_{acc}= 50 s onto the 10%(w/w)$CoFe_2O_4$/CPE a) a=5mV, b) a=10mV, c) a=15mV, d) a=20mV, e) a=25mVand f) a=30mV.

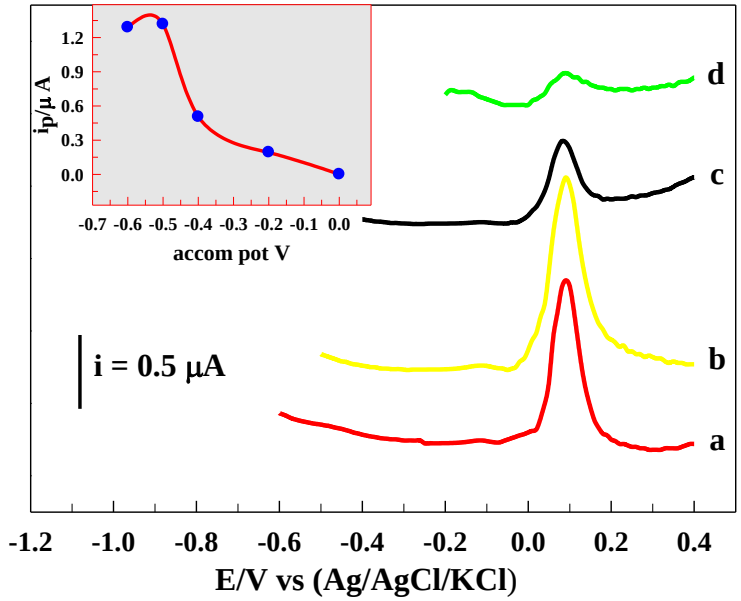

Fig S4. Voltammogrames and its corresponding plots for the effect of accumulation potential on the DPASV peak current intensity for 50 ppb Cu in the B-R universal buffer solutions of pH=4 at t_{acc}= 50 s onto the 10%(w/w)$CoFe_2O_4$/CPE.

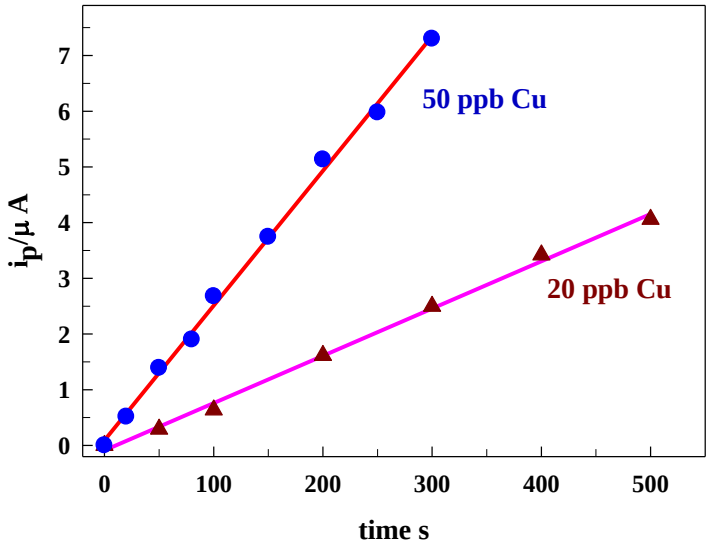

Fig. S5 Effect of preconcentration time t_{acc} on DP-ASV peak current for Cu(II) in the B-R universal buffer of pH 4 at E_{acc}=─0.5 V onto 10%(w/w)$CoFe_2O_4$/CPE.

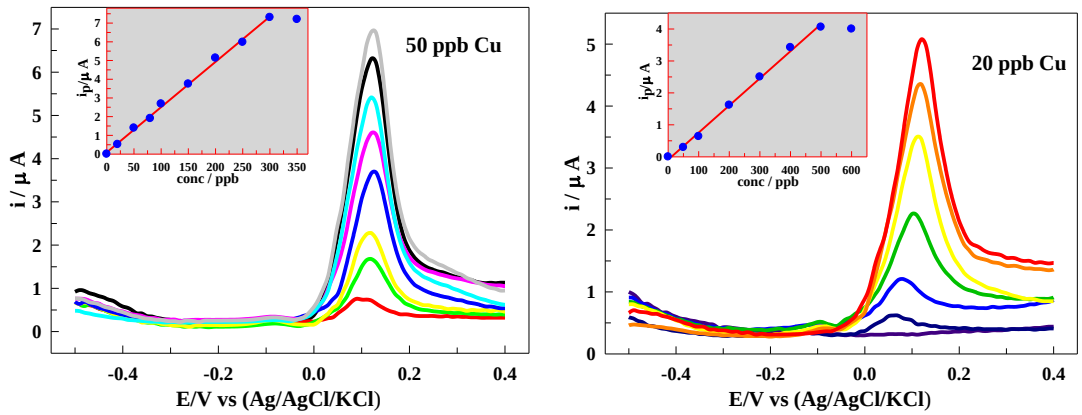

Fig. S6 DP-dAS voltammogrames recorded in the B-R buffer of pH 4 for 50 ppb and 20 ppb of copper in bulk form at 10%(w/w)$CoFe_2O_4$/CPE at various preconcentration for at E_{acc}= ─0.5 V.

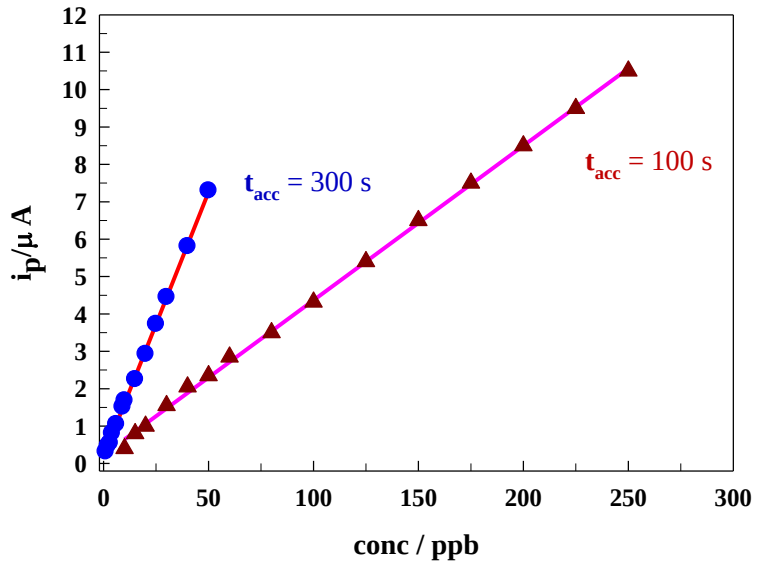

Fig S7 DP-ASV voltammogrames recorded in the B-R buffer of pH 4 for various concentrations of Cu(II) in bulk format 10%(w/w) $CoFe_2O_4$/CPE after preconcentration for 300 and 100 s at E_{acc}= ─0.5 V.

Table S1 Results of intra–day and inter–day assays of various concentrations of bulk Cu by the optimized DP-AdASV method utilizing using 10%(w/w)$CoFe_2O_4$/CPE .

Day	[Taken] / M	Mean[Found] M	%R	% Bias	Precision RSD %
			Intra–day		
	10	9.99	99.90	– 0.10	1.00
	50	50.30	100.60	0.60	0.9
	100	99.97	99.97	– 0.03	0.74
			Inter–day		
1	10	10.02	100.20	0.20	1.00
	50	50.01	100.20	0.20	0.92
	100	101.02	101.02	1.02	0.78
2	10	9.99	99.9	– 0.10	1.01
	50	51.02	102.04	2.04	0.91
	100	100.11	100.11	0.11	0.77
3	10	9.97	99.70	– 0.30	0.98
	50	49.88	99.76	– 0.24	0.88
	100	98.78	98.78	– 1.22	0.68

Table S2 Validation studies for determination of 40 ppb Cu at t_{acc}= 300s and 150 ppb Cu at t_{acc}= 100s by means of the described DP-AdASV method onto CPE and 10%(w/w)$CoFe_2O_4$/CPE.

Variables	**Operational Conditions**	**R ± RSD.% (n = 3)**
pH 3.50 4.00 4.50	E_{acc} = ─0.50 V	98.95 99.58 99.99
Preconcentration potential *(E_{acc})* ─0.55 ─0.50 ─0.45	pH = 4.00	99.85 99.58 100.01
Preconcentration time *(t_{acc})* 95 100 105 290 300 310	pH =4.00 E_{acc} = –0.50 V	97.18 100.55 101.25 98.53 99.98 10.66

Table S3 Interferences from foreign species on analysis of 150 ppb Cu at t_{acc}= 100 s by the optimized DP-AdASV method utilizing the onto 10%(w/w)$CoFe_2O_4$/CPE.

Foreign species	(M)
Na^+ and K^+	5.50×10^{-3}
Ca^{2+}, Mg^2	4.00×10^{-4}
Cl^-, SO_4^{-2} , PO_4^{-3} and Ac^-	4.60×10^{-3}
Oxalic acid, uric acid, glucose, sucrose, starch, gelatin and lactose	5.00×10^{-4}
Vitamins A,C and E	5.00×10^{-5}
Zn^{2+},Cd^{2+}, Al^{3+}, Se^{4+}, Pb^{2+}, As^{2+}, Sn^{2+} and Fe^{3+}	3 **:** 25 ppm

*For 5 % signal error