Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Effects of modified fly ash doped carbon paste electrodes and metal film electrodes on the determination of trace cadmium (II) by anodic stripping voltammetry

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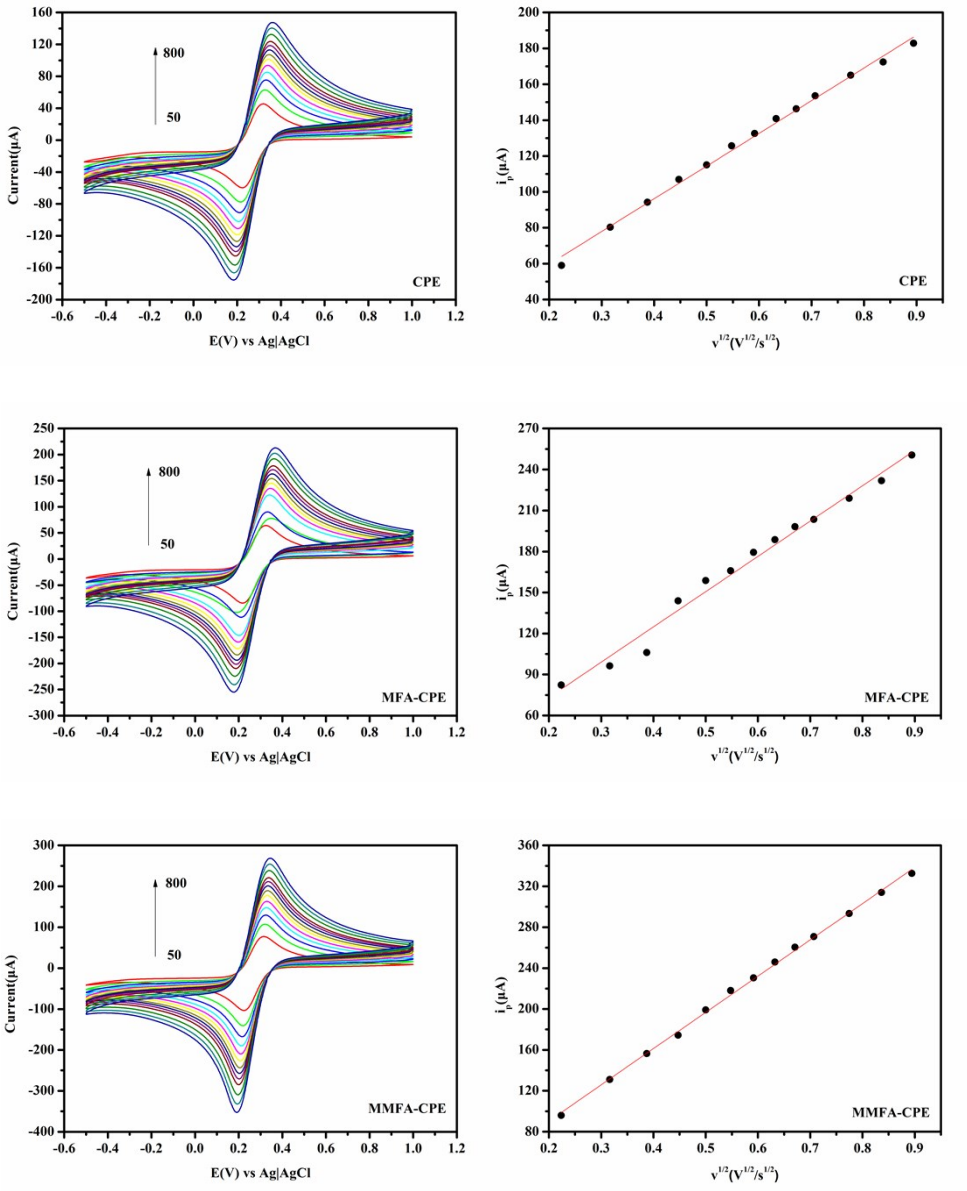

Fig.S1 CV profiles of CPE, MFA-CPE and MMFA-CPE in 5mM $[Fe(CN)_6]^{3-/4-}$ containing 1M KCl with different scan rates (50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 600, 700 and 800 mV/s) and plots of i_p vs. $v^{1/2}$.

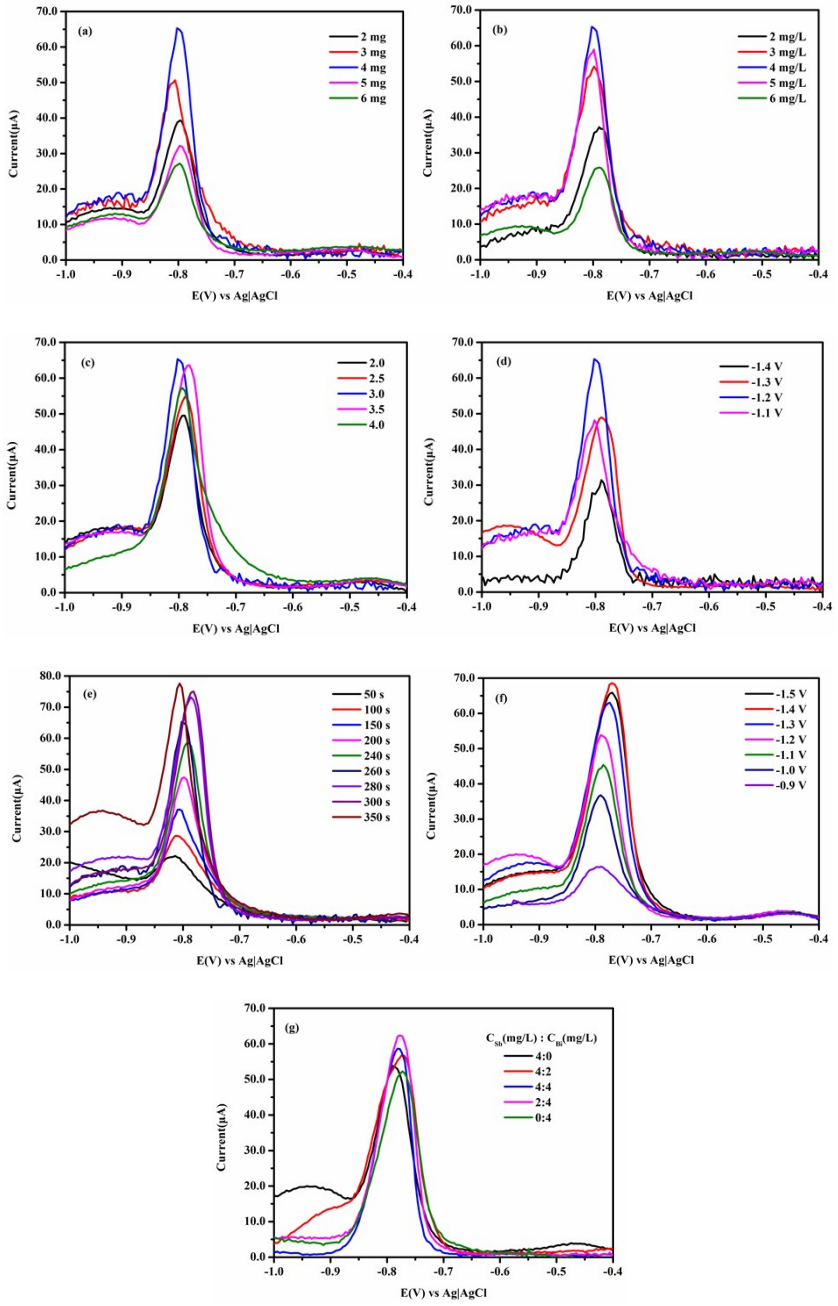

Fig.S2 Effect of different (a) amounts of MFA, (b) amounts of Sb(III), (c) pH, (d) deposition potential and (d) deposition time on the SWASV response of 80.0 μg/L Cd(II) at Sb/MFA-CPE. Effect of different (f) deposition potential on the SWASV response of 80.0 μg/L Cd(II) at Sb/MMFA-CPE. Effect of different (g) amounts of Sb(III) and Bi(III) on the SWASV response of 80.0 μg/L Cd(II) at Sb-Bi/MMFA-CPE.

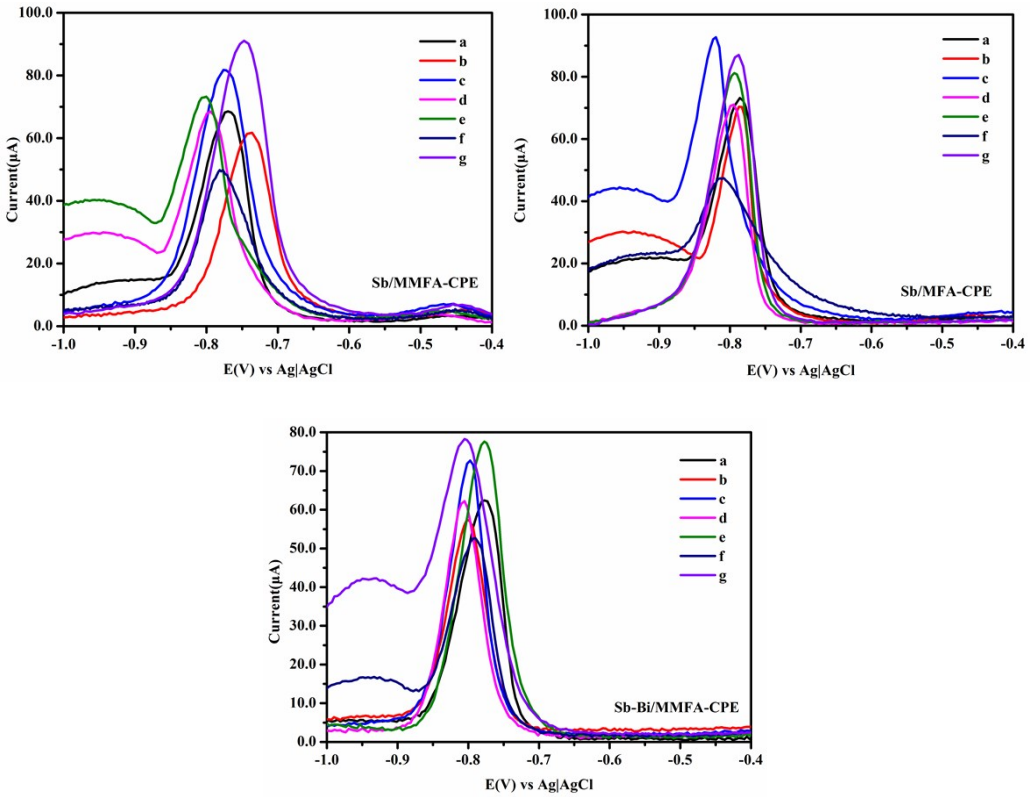

Fig.S3 SWASV responses of 80 μg/L Cd(Ⅱ) at Sb/MFA-CPE, Sb/MMFA-CPE and Sb-Bi/MMFA-CPE with pulse amplitude, the frequency and scan rate of (a) 50, 25 and 100, (b) 40, 25 and 100, (c) 60, 25 and 100, (d) 50, 20 and 100, (e) 50, 30 and 100, (f) 50, 25 and 50, (g) 50mV, 25Hz and 150mV/s, respectively.

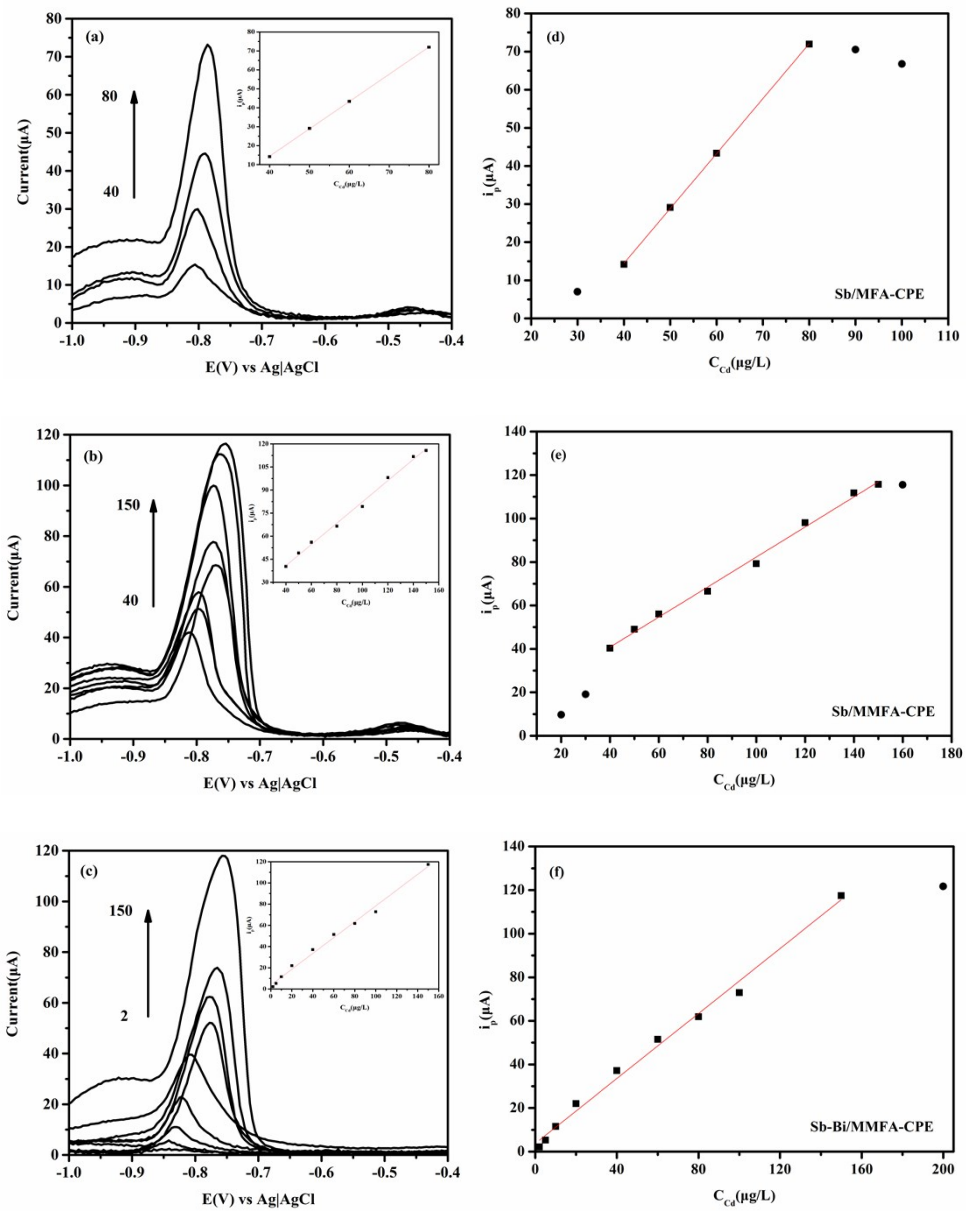

Fig.S4 SWASV responses of Cd(II) of different concentrations at (a) Sb/MFA-CPE, (b) Sb/MMFA-CPE and (c) Sb-Bi/MMFA-CPE. The inset (a, b and c) and (d, e and f) show the calibration curves for the determination of Cd(II) of different concentrations.

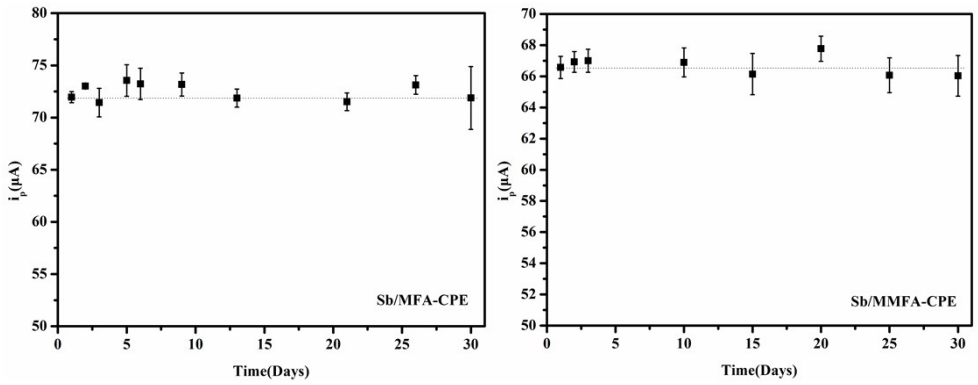

Fig.S5 Long-term stability of MFA-CPE and MMFA-CPE.

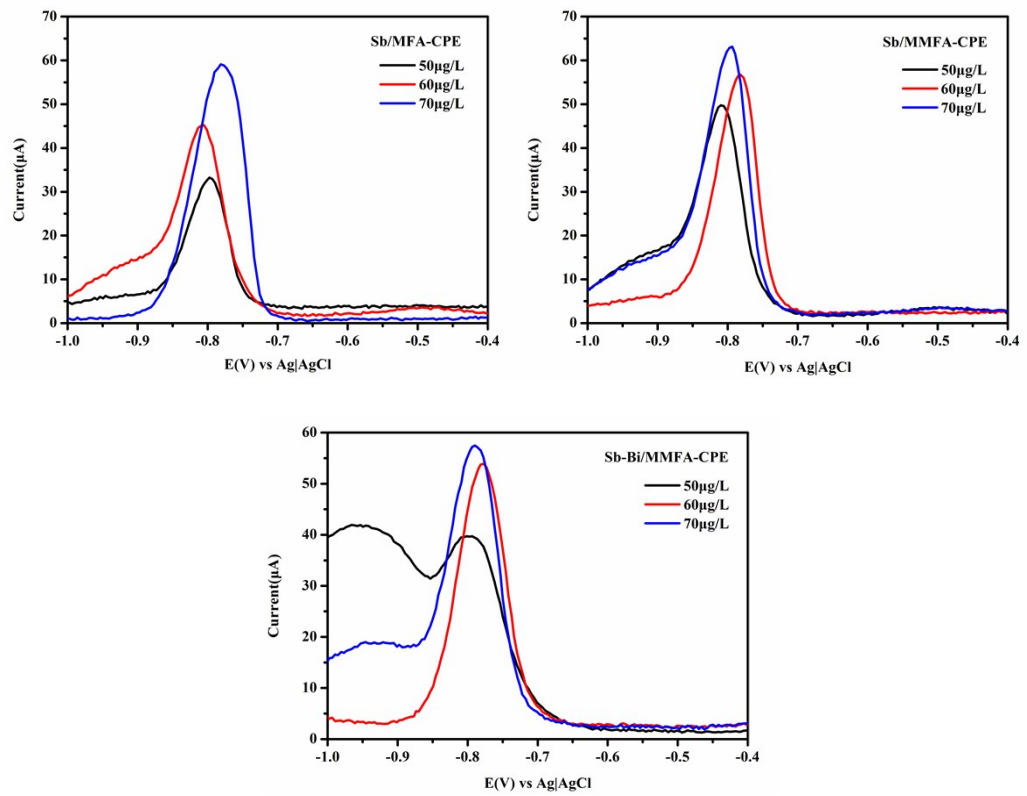

Fig.S6 SWASV responses of 50, 60 and 70 μg/L Cd(Ⅱ) at Sb/MFA-CPE, Sb/MMFA-CPE and Sb-Bi/MMFA-CPE in the sample with 0.1 mL tap water.

Table S1 Electrochemical data of CPE, MFA-CPE and MMFA-CPE in 5mM $[Fe(CN)_6]^{3-/4-}$ containing 1M KCl at a scan rate of 150mV/s.

Electrodes	ΔE_P (mV)	I_{Pa} (μA)	*A (cm^2)
CPE	122.38	94.21	0.049
MFA-CPE	121.46	106.07	0.070
MMFA-CPE	108.59	156.47	0.096

*A, active surface area.

Table S2 Robustness results of the proposed method of three electrodes.

Electrodes	Variables		Recovery (%)	RSD (%)	Conditions
Sb/MFA-CPE	Deposition potential (E_d)	-1.19 V	101.85	0.42	E_a=50 mV pH=3
		-1.21 V	100.26	0.94	
	Pulse amplitude (E_a)	48 mV	100.30	1.41	E_d=-1.2 V pH=3
		52 mV	100.30	3.29	
	pH	2.92	101.39	0.97	E_d=-1.2 V E_a=50 mV
		3.07	100.31	1.43	
Sb/MMFA-CPE	Deposition potential (E_d)	-1.39 V	99.78	1.87	E_a=50 mV pH=3
		-1.41 V	99.90	0.83	
	Pulse amplitude (E_a)	48 mV	100.46	0.93	E_d=-1.4 V pH=3
		52 mV	100.07	0.83	
	pH	2.9	99.54	1.13	E_d=-1.4 V E_a=50 mV
		3.06	101.81	1.16	
Sb-Bi/MMFA-CPE	Deposition potential (E_d)	-1.19 V	101.26	1.60	E_a=50 mV pH=3
		-1.21 V	100.47	1.16	
	Pulse amplitude (E_a)	48 mV	100.76	2.14	E_d=-1.2 V pH=3
		52 mV	100.30	0.75	
	pH	2.94	101.87	0.61	E_d=-1.2 V E_a=50 mV
		3.02	99.78	0.98	

Table S3 Some analytical methods for the determination of toxic metals.

Electrode substrate	Modified material	Film electrode	Method	Linearity range (μg/L)	Detection limit (μg/L)	Ref.
Carbon paste electrode	FA modified with NaOH	Sb	ASV	40-80(Cd)	2.63	This work
	FA modified with NaOH and CTAB	Sb	ASV	40-150(Cd)	2.25	
		Sb-Bi	ASV	2-150(Cd)	1.36	
Carbon paste electrode	Sodium montmorillonite	Sb	ASV	4-150 (Cd)	0.25	[1]
Carbon paste electrode	Montmorillonite	Bi	ASV	1-24 (Pb, Cd)	0.2(Pb) 0.35(Cd)	[2]
Carbon paste electrode	Multi-walled carbon nanotubes	Sb	ASV	10-60 (Pb, Cd)	0.65(Pb) 0.77(Cd)	[3]
Carbon paste electrode	Zeolite	Bi	ASV	1-20 (Pb, Cd)	0.1(Pb) 0.08(Cd)	[4]
Conductive polymer electrode	/	Sb	ASV	0-120 (Pb, Cd)	0.95(Pb) 1.3(Cd)	[5]
Screen-printed electrode	/	Te	ASV	2-35(Cu)	0.5	[6]
Glassy carbon electrode	/	Sb	ASV	2-100(Cd) 5-100(Pb) 2-100(Tl) 20-200(Zn) 10-100(In) 0-50(Cu)	0.7(Cd) 1.5(Pb) 1.0(Tl) 3.8(Zn) 1.4(In) 0.5(Cu)	[7]

Table S4 Reproducibility of three electrodes tested with 80.0 μg/L Cd(II).

Electrodes	i_p (μA)			Average (μA)	RSD (%)
	Day 1	Day 2	Day 3		
Sb/MFA-CPE	71.96	73.02	71.44	72.14	1.12
Sb/MMFA-CPE	66.57	66.93	67.01	66.84	0.35
Sb-Bi/MMFA-CPE	61.89	62.78	62.496	62.39	0.73

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