Supplementary material for

Ferrocene-containing gallic acid derivative modified carbon nanotubes electrode for fast and simple simultaneous or selective cytostatic from aqueous solutions

Sorina Motoc (m. Ilies)[1], Adelina Andelescu[1], Alexandru Visan[1], Anamaria Baciu[2], Elisabeta I. Szerb[1], and Florica Manea[2,*]

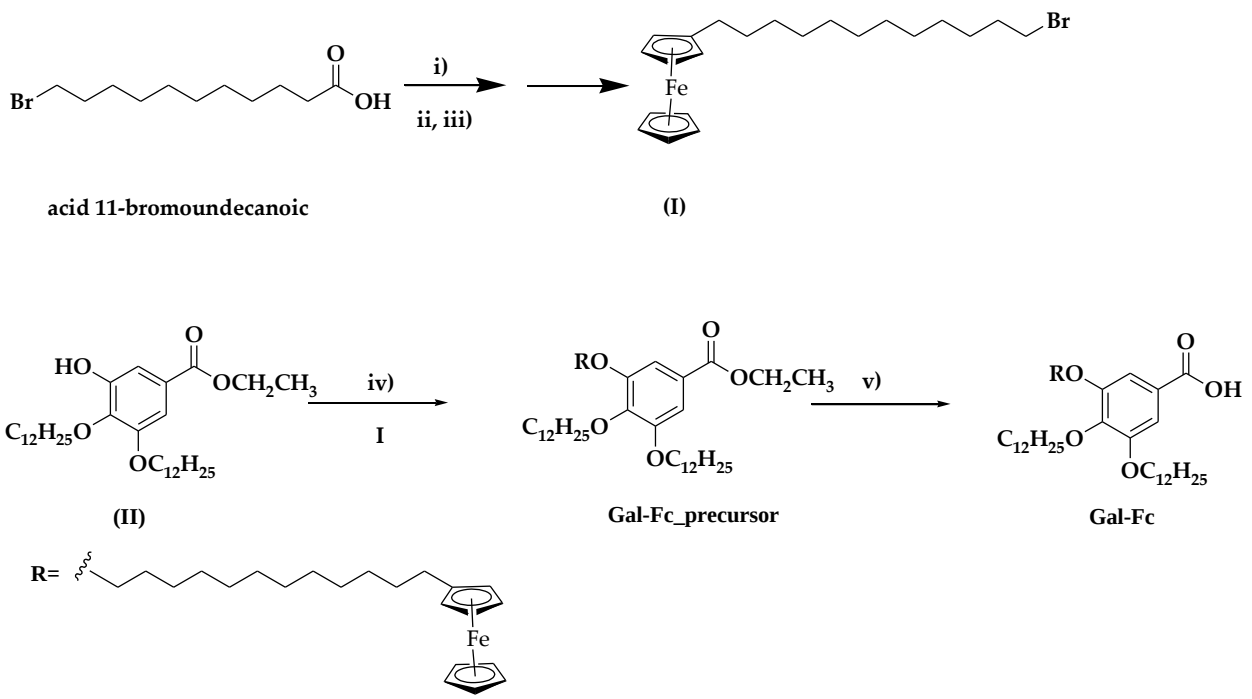
[1]"Coriolan Drăgulescu" Institute of Chemistry, Romanian Academy, 24 Mihai Viteazu Bvd., 300223 Timisoara, Romania

[2] Department of Applied Chemistry and Engineering of Inorganic Compounds and Environment, Politehnica University of Timisoara, Bvd. Vasile Parvan No. 6, 300223 Timisoara, Romania

* Correspondence: florica.manea@upt.ro

Table of contents:

1. Experimental section



Scheme S1. Synthetic pathway for the synthesis of Gal-Fc. Reagents and conditions: (i) $SOCl_2$, toluene, 70°C, inert atmosphere, 24 h; (ii) ferrocene, $AlCl_3$, DCM, 0°C, inert atmosphere, 24 h at r.t; (iii) $AlCl_3$, $NaBH_4$, THF, 0°C, inert atmosphere, 24 h at r.t; (iv) K_2CO_3, DMF, 80°C, 24 h; (v) KOH, EtOH, ΔT.

Compound I was obtained according to a previously published procedure.[1]

Synthesis of compound II:

Ethyl 3,4,5-trihydroxybenzoate (1.0 g, 5.05 mmol) and K_2CO_3 (1.34 g, 10.1 mmol) in 20 mL cyclohexanone were mechanically stirred at 60°C for 30 minutes, then 1-bromododecane (2.52 g, 10.1 mmol) was quickly added. The reaction mixture was stirred at 90°C overnight, then cooled to room temperature, filtered over cellite, and the solvent was evaporated. The residue was taken in DCM, washed with water (3 x 150 mL) and brine (1 x 100 mL), then the organic phase was dried over anhydrous Na_2SO_4, filtered and taken to dryness. The pure product was obtained by column chromatography (SiO_2/chloroform:hexane = 1:1) as a white solid. (2.4 mmol, 47%)

^{1}H NMR (300 MHz, Chloroform-d, δ/ppm): 7.32 (d, *J* = 1.8 Hz, 1H), 7.18 (d, *J* = 1.9 Hz, 1H), 5.87 (s broad, 1H, -OH), 4.15 (t, *J* = 6.7 Hz, 2H), 4.04 (t, *J* = 6.4 Hz, 2H), 4.09 (m, 2H,), 1.79 (overlapped peaks, 4H), 1.56 – 1.18 (overlapped peaks, 38 H), 0.89 (t, 3 J = 6.6 Hz, 6H).

Synthesis of Gal-Fc: Compound II (1.00 g, 1.87 mmol) and K_2CO_3 (0.80 g, 5.75 mmol) in DMF was stirred at 60°C for 30 minutes, followed by the addition of compound I in DMF. The temperature was set at 80°C, and was stirred at this temperature overnight. After the evaporation of the solvent, the residue was taken with DCM, and washed with water and brine. The organic layer was dried over anhydrous Na_2SO_4, filtered and dried under reduced pressure. The pure product was isolted after purification on column chromatography on SiO_2, using hexane:AcOEt = 9:1 as eluent, as yellow glassy solid.

^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.27 (d, *J* = 1.6 Hz, 2H), 4.37 (q, *J* = 7.1 Hz, 2H), 4.13 – 3.98 (m, 16H), 2.42 – 2.19 (m, 2H), 1.79 (ddd, *J* = 22.0, 8.5, 6.4 Hz, 6H), 1.57 – 1.35 (m, 12H), 1.29 (d, *J* = 5.9 Hz, 48H), 0.90 (t, *J* = 6.5 Hz, 6H).

FT-IR (KBr, cm^{-1}): $\nu_{C-H,Fc}$ (3097), $\nu_{CH2,as}$ (2925), $\nu_{CH2,s}$ (2854), $\nu_{C=O}$ (1719), $\nu_{Cp-Fe,\ Fc}$ (485)

The above isolated compound was hydrolised in a basic media (using 2 eq KOH) in ethanol/thf mixture under reflux. After the completion of the reaction the mixture was concentrated under reduced pressure and water was added, acidified with HCl to neutral pH, and the formed precipitate was isolated by filtration. Further, the pure compound was obtained after purification on SiO_2, using hexane:AcOEt = 9:1 to hexane:AcOEt = 7:3 as eluent.

^{1}H NMR (300 MHz, Chloroform-*d*) δ 7.32 (s, 2H), 4.14 – 3.99 (overlapped, 15H), 2.44 – 2.20 (m, 2H), 1.91 – 1.69 (m, 6H), 1.57 – 1.26 (m, 55H), 0.90 (t, *J* = 6.5 Hz, 6H).

FT-IR (KBr, cm^{-1}): $\nu_{C-H,Fc}$ (3098), $\nu_{CH2,as}$ (2925), $\nu_{CH2,s}$ (2855), $\nu_{C=O}$ (1678), $\nu_{Cp-Fe,\ Fc}$ (485)

Elemental analysis: Anal. Calcd. for $C_{52}H_{84}FeO_5$ (845.07 $g \cdot mol^{-1}$): C, 73.91; H, 10.02; Found: C, 73.73; H, 9.98.

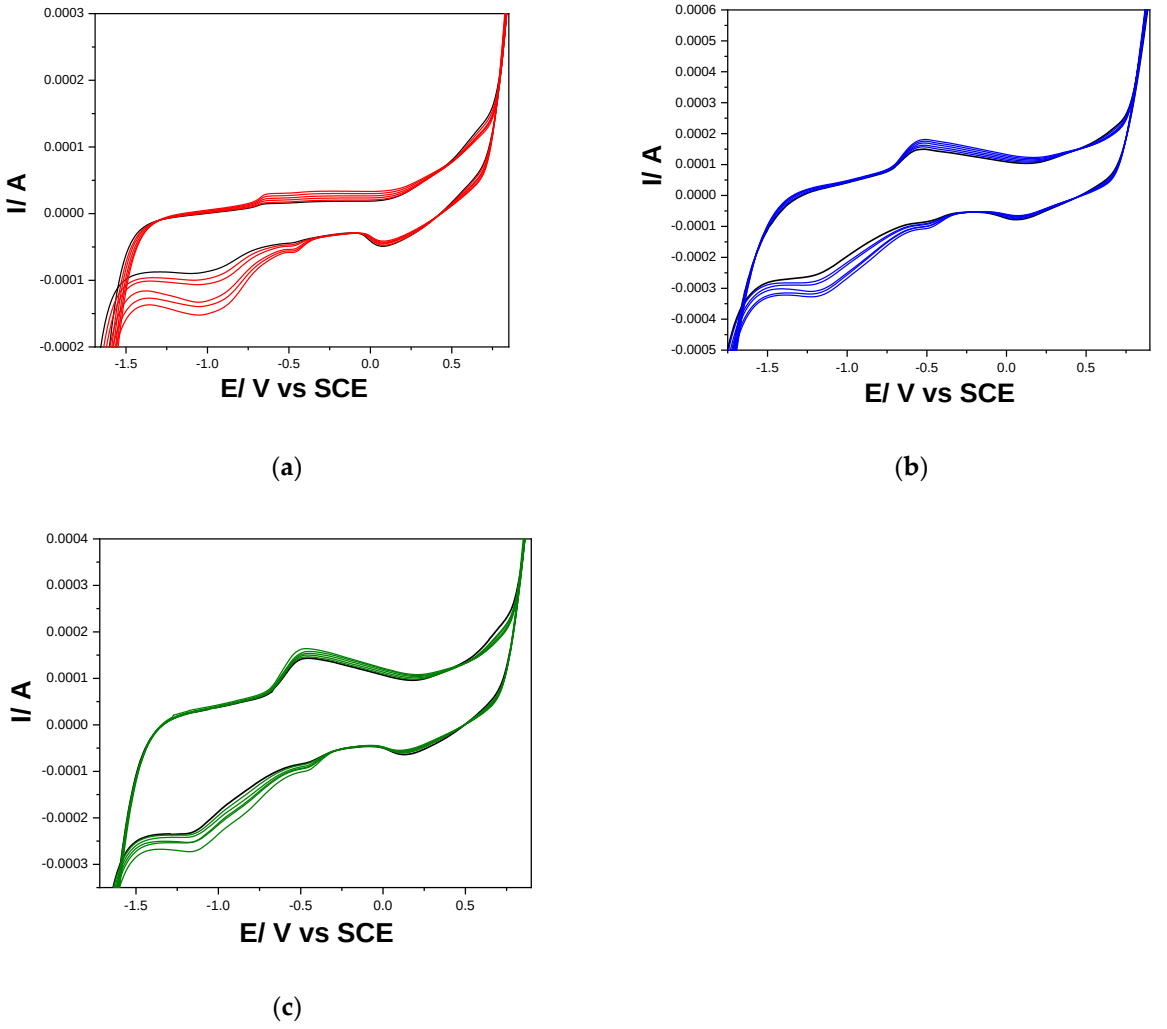


Figure S1. CVs recorded with Gal-Fc-CNT electrode in 0.1 M NaOH supporting electrolyte within the potential range from -2.00 to +1.00 V/SCE at the scan rate of 0.05 $V \cdot s^{-1}$ in the presence of: (a) 1-5 $mg \cdot L^{-1}$CPP (red line); (b) 1-5 $mg \cdot L^{-1}$CPB (blue line); (c) 1-5 $mg \cdot L^{-1}$DOX (green line).

Table S1. The electroanalytical performance obtained with Gal-Fc-CNT paste electrode.

Electrode/ Detection	Technique/ Conditions	Analyte	Peak potential V vs. SCE	Sensitivity ($\mu A^{\bullet} mg \cdot L^{-1}$)	LOD ($mg \cdot L^{-1}$)	LQ ($mg \cdot L^{-1}$)	RSD (%)	Correlation coefficient (R^2)
Gal-Fc-CNT	DPV/pH=3	DOX	-0.46	40.25	0.0068	0.022	1.38	0.930
			+0.45	269.5	0.0028	0.0093	0.49	0.917
	SWV/pH=3	DOX	+0.47	1430	0.00075	0.0025	0.50	0.981
	DPV/pH=12	DOX	-0.20	73.71	0.00071	0.0024	0.11	0.992
		CPB	-0.20	5.00	0.055	0.183	1.45	0.840
		CPP	-0.20	6.55	0.044	0.146	1.55	0.829
	SWV/pH=12	DOX	-0.60	311.9	0.0078	0.026	3.46	0.990
		CPB	-0.60	22.90	0.013	0.044	0.14	0.849
		CPP	-0.60	30.25	0.009	0.030	0.13	0.827

References

[1] Popa, E.; Andelescu, A.A.; Ilies (b. Motoc), S.; Visan, A.; Cretu, C.; Scarpelli, F.; Crispini, A.; Manea, F.; Szerb, E.I. Hetero-Bimetallic Ferrocene-Containing Zinc(II)-Terpyridyl-Based Metallomesogen: Structural and Electrochemical Characterization. *Mater*. **2023**, *16*(5), 1946. doi: 10.3390/ma16051946