Supporting Information

Photoinduced Electron Transfer (PET) in Ethaline-like solvents

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Supporting information

Table of Contents

1. Synthesis of quenchers

1.1 Synthesis of 2,11-Dimethyl-6,7-dihydrodipyrido[1,2-a:2′,1′-c]pyrazinediium dibromide (DMPP-DB)

A solution of 1.656 g (9 mmol, 1 e.q.) of 4,4'-dimethyl-2,2'-bipyridine in 45 mL (522 mmol, 58 e.q.) of 1,2-dibromoethane was refluxed for 40 h at 125 ℃, during which time a precipitate was formed. The mixture was cooled and filtered, and the precipitate was washed with acetone and chloroform to afford 2.489 g (74% yield) of a white-pinkish crystalline solid identified as 12A: NMR (D2O at 4.7): 2.78 (s, 6 H), 5.19 (s, 4 H), 8.13 (d, 2 H, J = 6 Hz), 8.75 (s, 2 H), 8.93 (d, 2 H, J = 6 Hz).

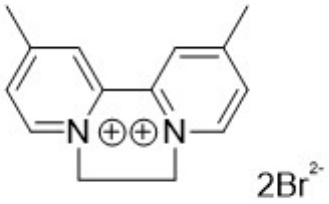

Figure S1A. chemical structure of salt DMPP-DB**.**

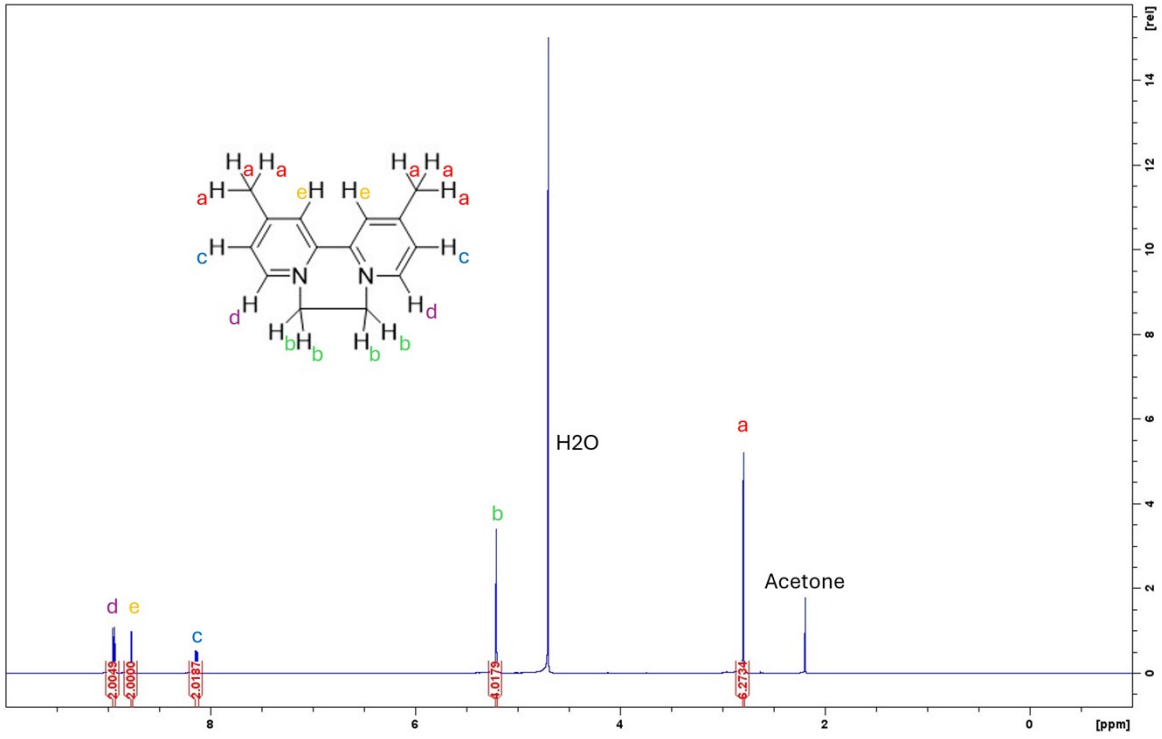

Figure S1B. [1]H-NMR spectrum of salt DMPP-DB.

1.2 Synthesis of 2,12- Dimethyl-7,8-dihydro-6Ff-dipyrido[l,2-a :2',l'-c]-[l,4]diazepinium Dibromide (DMDHP-DB)

A solution of 1.105 g (6 mmol, 1 e.q.) of 4,4'-dimethyl-2,2'-bipyridine in 15 mL (150 mmol, 25 e.q.) of 1,3-Dibromopropane was refluxed for 40 h at 125 ℃, during which time a precipitate was formed. The mixture was cooled and filtered, and the precipitate was washed with acetone and chloroform to afford 2.212 g (95% yield) of a white-pinkish crystalline solid identified as 12A: NMR (D2O at 4.7): 2.76 (s, 6 H), 2.83-2.93 (m, 2 H), 4.37-4.49 (m, 2 H,), 4.89-4.98 (dt, 2 H, J = 15 Hz), 8.15 (d, 2 H, J = 7 Hz), 8.28 (s, 2 H), 8.96 (d, 2 H, J = 6 Hz).

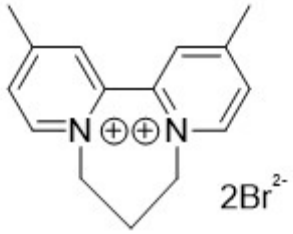

Figure S2A. Chemical structure of salt DMDHP-DB**.**

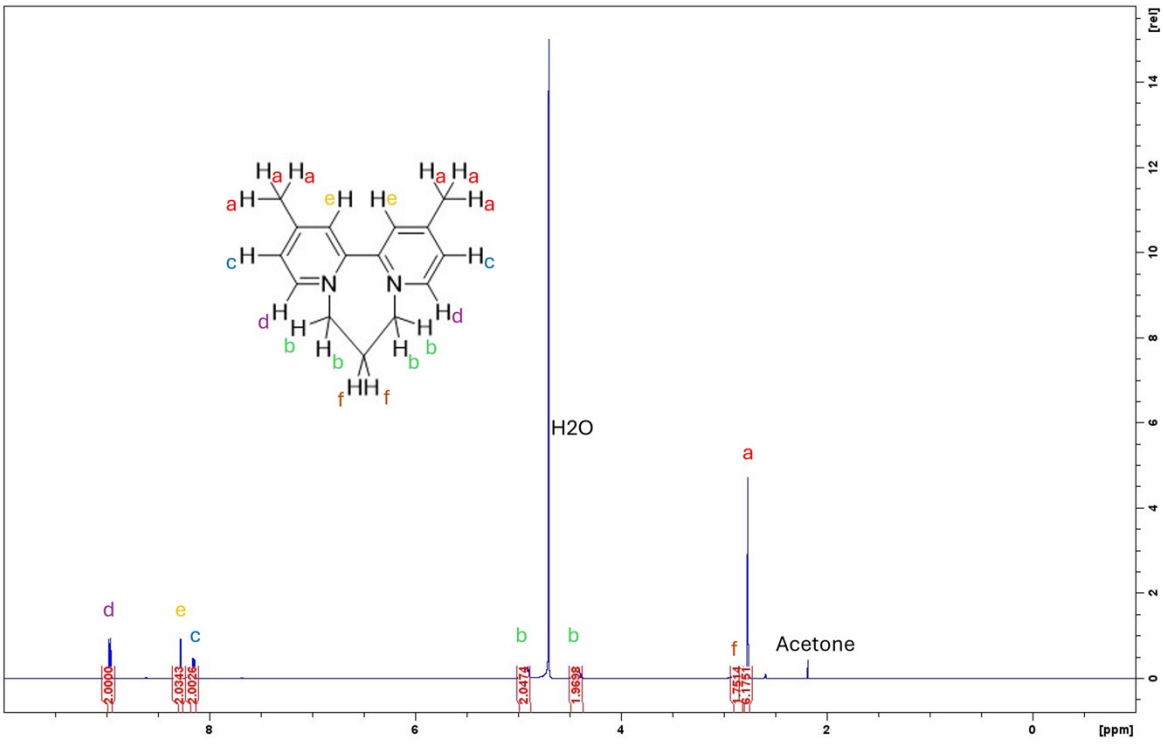

Figure S2B. [1]H-NMR spectrum of salt DMDHP-DB.

1.3 Synthesis of 6,7,8,9-tetrahydro-2,13-dimethyldipyrido<1,2-a:2',1'-c><1,4>diazocinediium dibromide (THDDP-DB)

A solution of 0.1842 g (1 mmol, 1 e.q.) of 4,4'-dimethyl-2,2'-bipyridine in 1.000 mL (9 mmol, 9 e.q.) of 1,4-Dibromobutane was refluxed for 27 h at 80 ℃, during which time a precipitate was formed. The mixture was cooled and filtered, and the precipitate was washed with acetone and chloroform to afford 2.256 g (68% yield) of a white-pinkish crystalline solid identified as 12C: NMR (D2O at 4.7): 2.08-2.15 (m, 2 H), 2.37-2.45 (m, 2 H), 2.74 (s, 6 H,), 4.04-4.15 (m, 2 H), 4.79 (dd, 2 H, J = 15 Hz), 8.14 (s, 2 H), 8.21 (d, 2 H, J = 6 Hz), 9.06 (d, 2 H, J = 6 Hz).

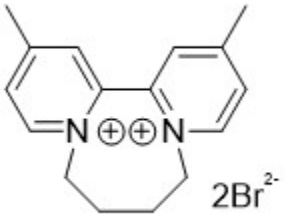

Figure S3A. Chemical structure of THDDP-DB**.**

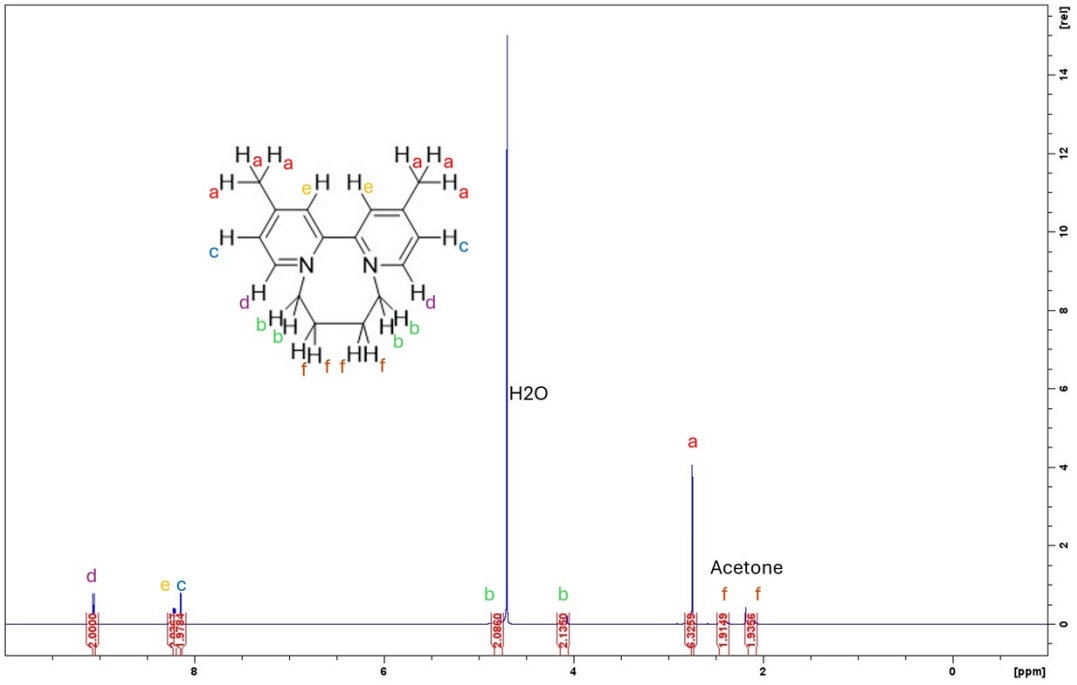

Figure S3B. ^{1}H-NMR spectrum of salt THDDP-DB**.**

1.4 Synthesis of 1,1',4,4'-Tetramethyl-2,2'-bipyridinium diiodide (TMBP-I_2)

A solution of 1.0133 g (5.5 mmol, 1 e.q.) of 4,4'-dimethyl-2,2'-bipyridine in 3.080 mL (49.5 mmol, 9 e.q.) of Iodomethane was refluxed for 18 h at 85 ℃ , in 12.5 mL of dry Acetonitrile, during which time a precipitate was formed. The mixture was cooled and filtered, and the precipitate was washed with acetone and Acetonitrile to afford 1.326 g (51% yield) of a yellowish crystalline solid identified as 12D: NMR (D2O at 4.7): 2.73 (s, 6 H), 4.10 (s, 6 H), 8.14-8.18 (m, 4 H,) 8.96 (d, 2 H, J = 6 Hz).

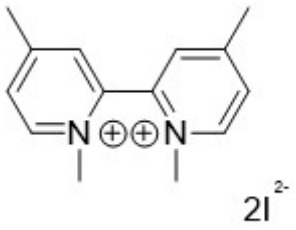

Figure S4A. Chemical structure of salt TMBP-I_2**.**

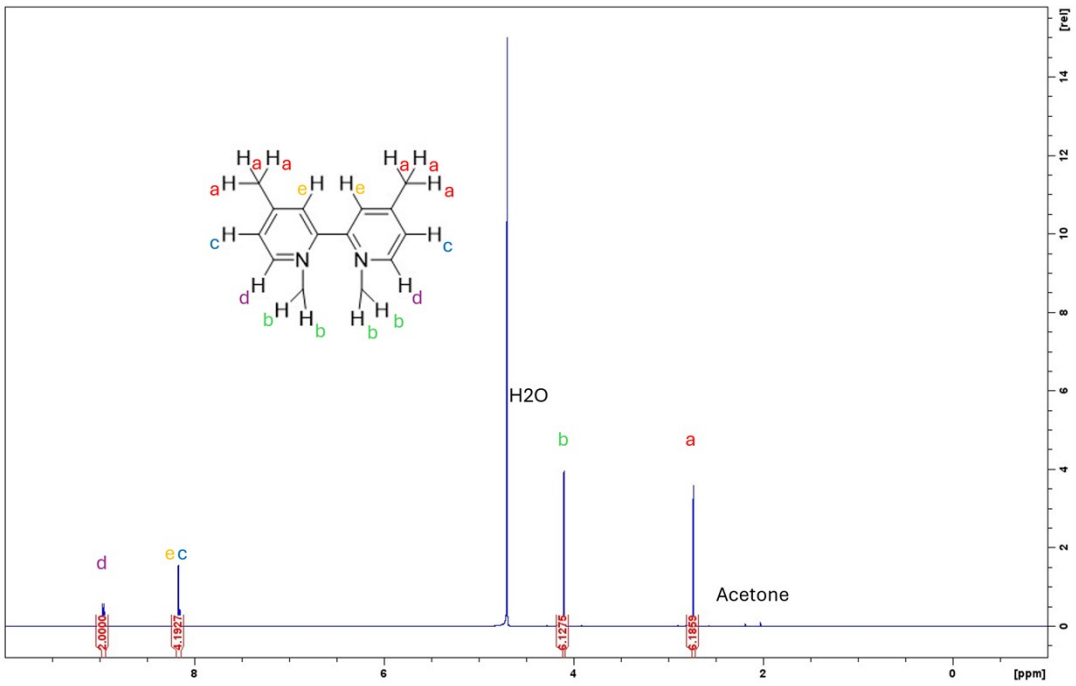

Fig. S4B. ^{1}H-NMR spectrum of salt TMBP-I_2**.**

2. Grunberg-Nissan viscosity model

$$\ln(\eta_{mix}) = x_1 \ln(\eta_1) + x_2 \ln(\eta_2) + x_1 x_2 G_{12} \qquad (S1)$$

Here x_1 and x_2 is mole fraction of ethaline, and water respectively, η_1, η_2, η_{mix} are viscosities of pure ethaline, water, and ethaline water mixtures, respectively.

Table S1. The experimental and predicted viscosities using Grunberg-Nissan viscosity model

DES%	ρ (g/mL)	x_1 of ethaline	x_1 of water	η_{exp} (Pa s)	η_{pred} (Pa s)	Absolute error (Pa s)	G_{12}
0	1.012	0	1	0.000991	0.000991	0	Undefine
10	1.014	0.02	0.98	0.001092	0.001189	0.000097	0.564
30	1.038	0.09	0.91	0.00188	0.001871	0.000009	4.098
50	1.060	0.18	0.82	0.00368	0.003472	0.000208	4.447
70	1.074	0.35	0.65	0.00853	0.008276	0.000254	4.183
90	1.094	0.67	0.33	0.0237	0.025248	0.001548	3.769
100	1.1174	1	0	0.0326	0.0326	0	Undefine

3. Photophysical characterization data for $[Ru(bpy)_3]^{2+}$

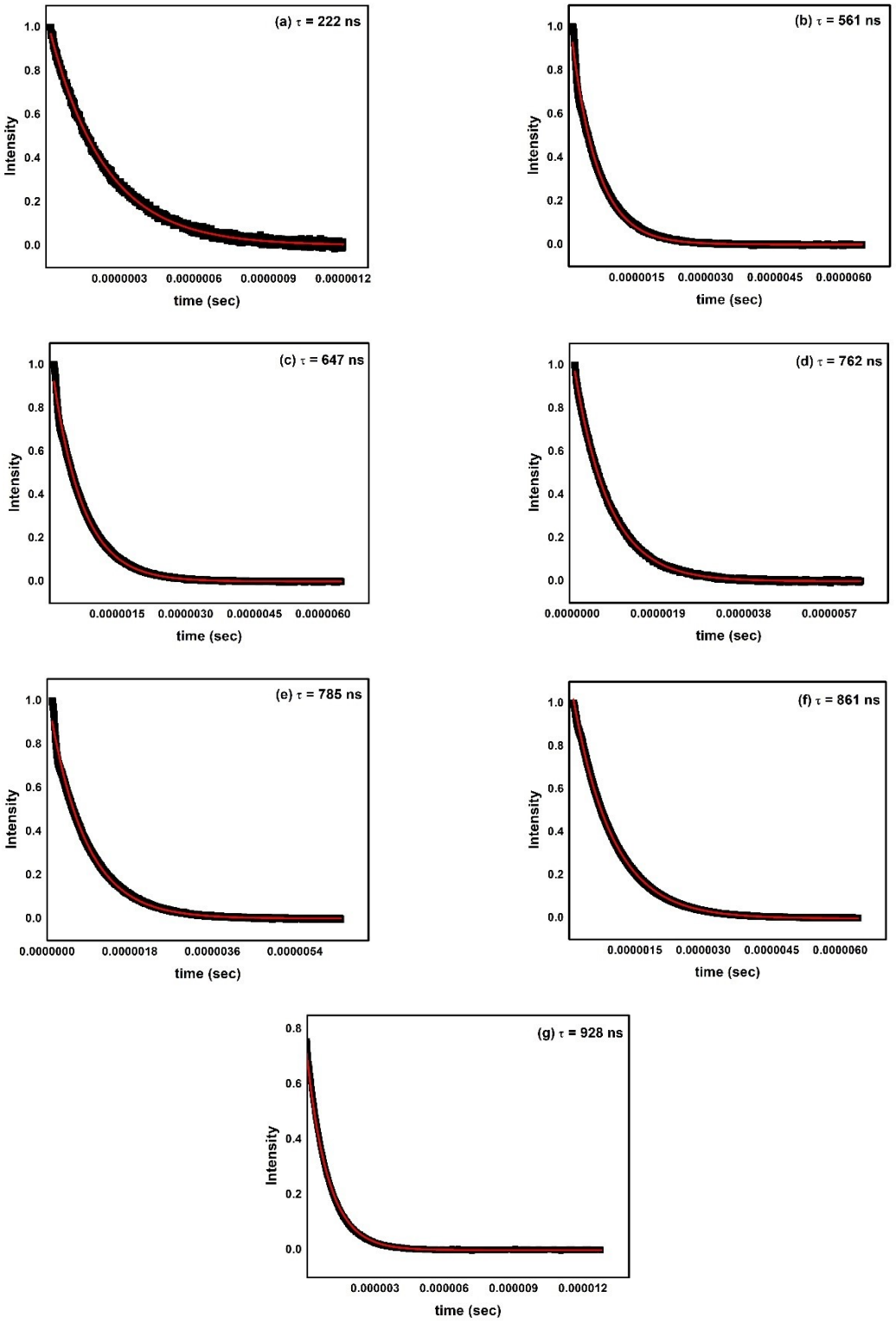

Fig. S5. Emission lifetime of tris(2,2′-bipyridine) ruthenium (II) hexafluorophosphate $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture and (f) 90% DES mixture (g) 100% DES mixture.

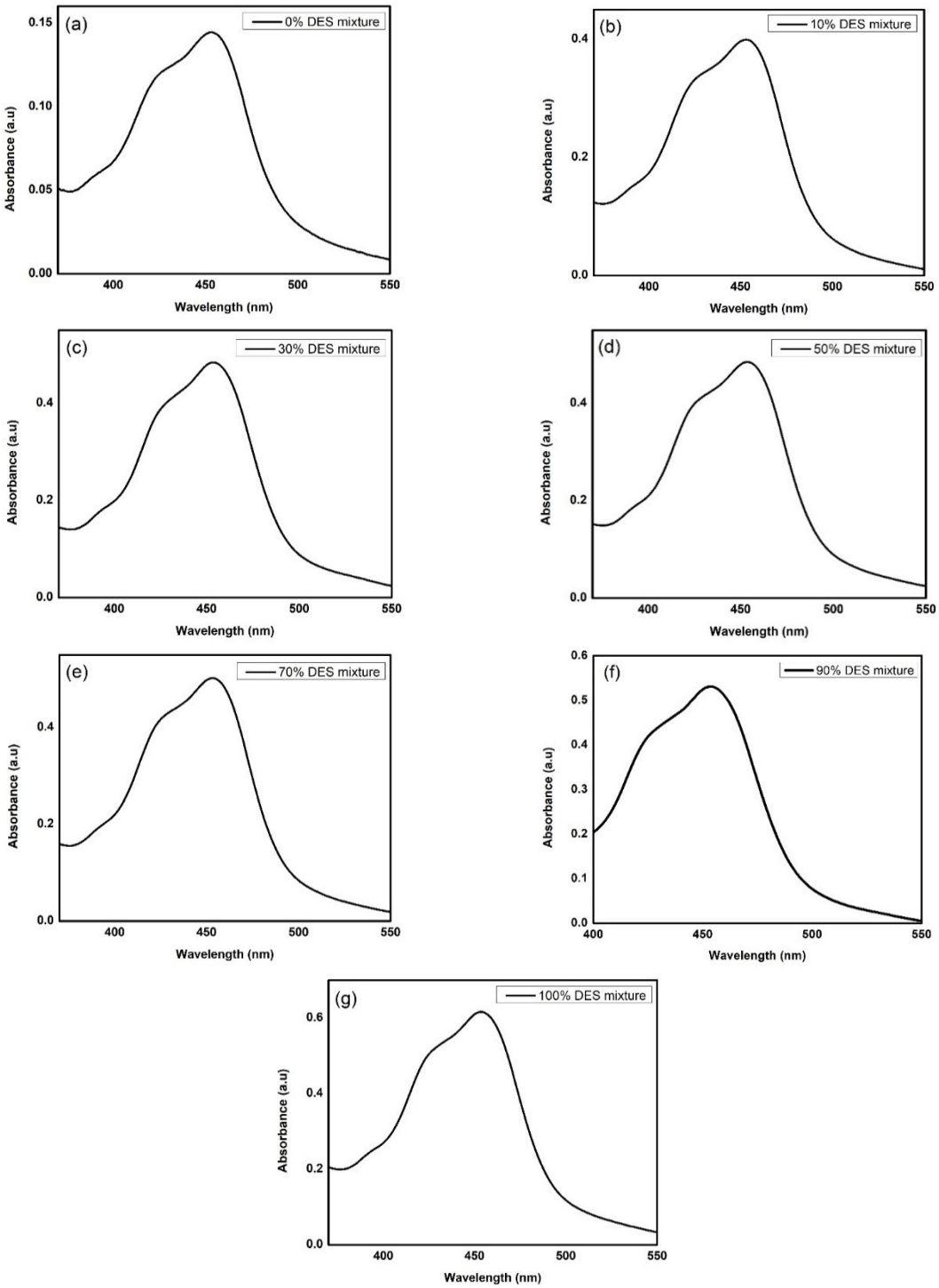

Fig. S6. UV-vis spectra of tris(2,2′-bipyridine) ruthenium (II) hexafluorophosphate $[Ru(bpy)_3]^{2+}$ in (a) 0% DES, (b)10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES mixture.

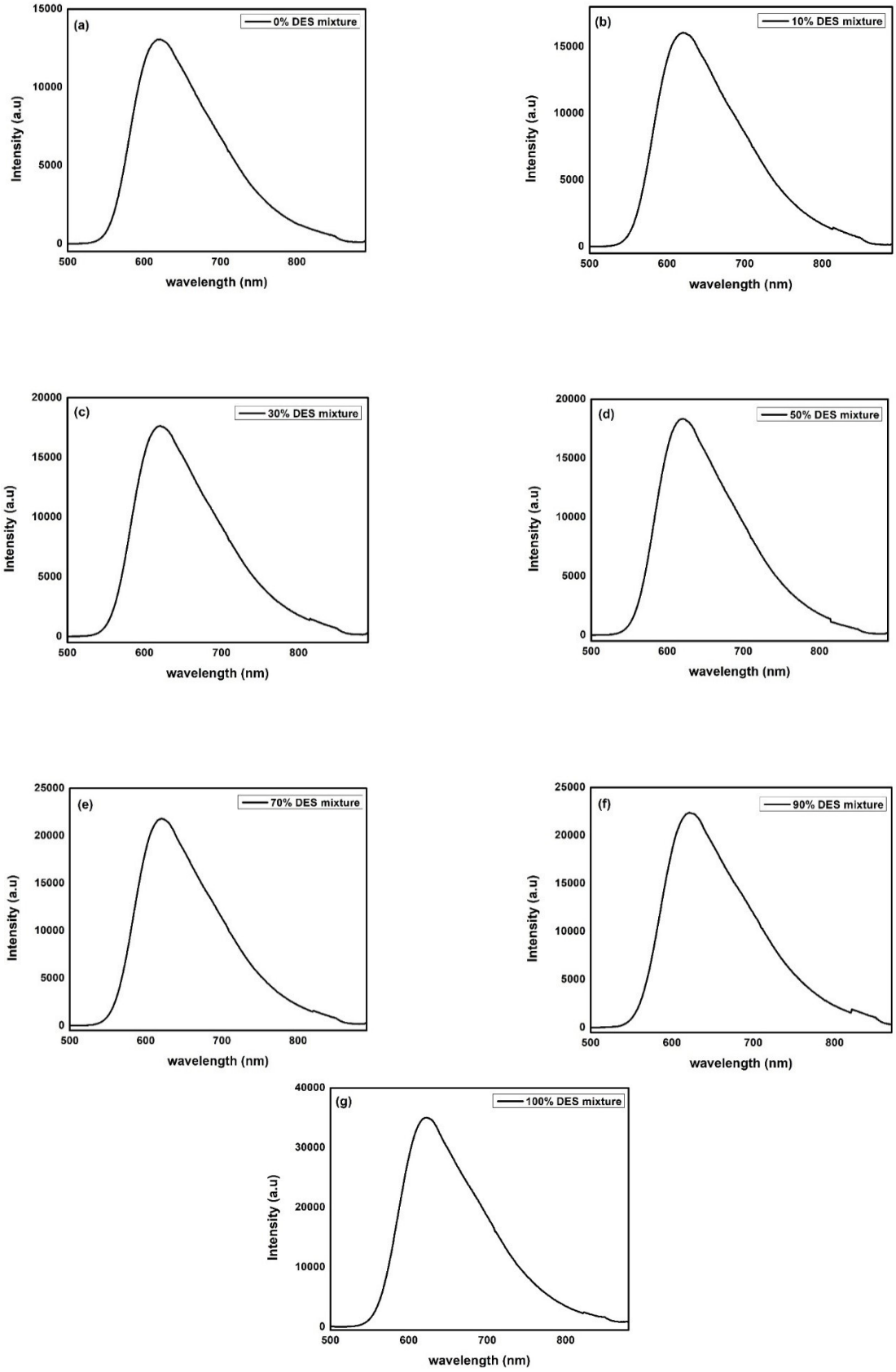

Fig. S7. Fluorescence emission spectra ($\lambda_{excitation}$ = 453 nm) of tris(2,2′-bipyridine) ruthenium (II) hexafluorophosphate $[Ru(bpy)_3]^{2+}$ in (a) 0% DES, (b)10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES mixture.

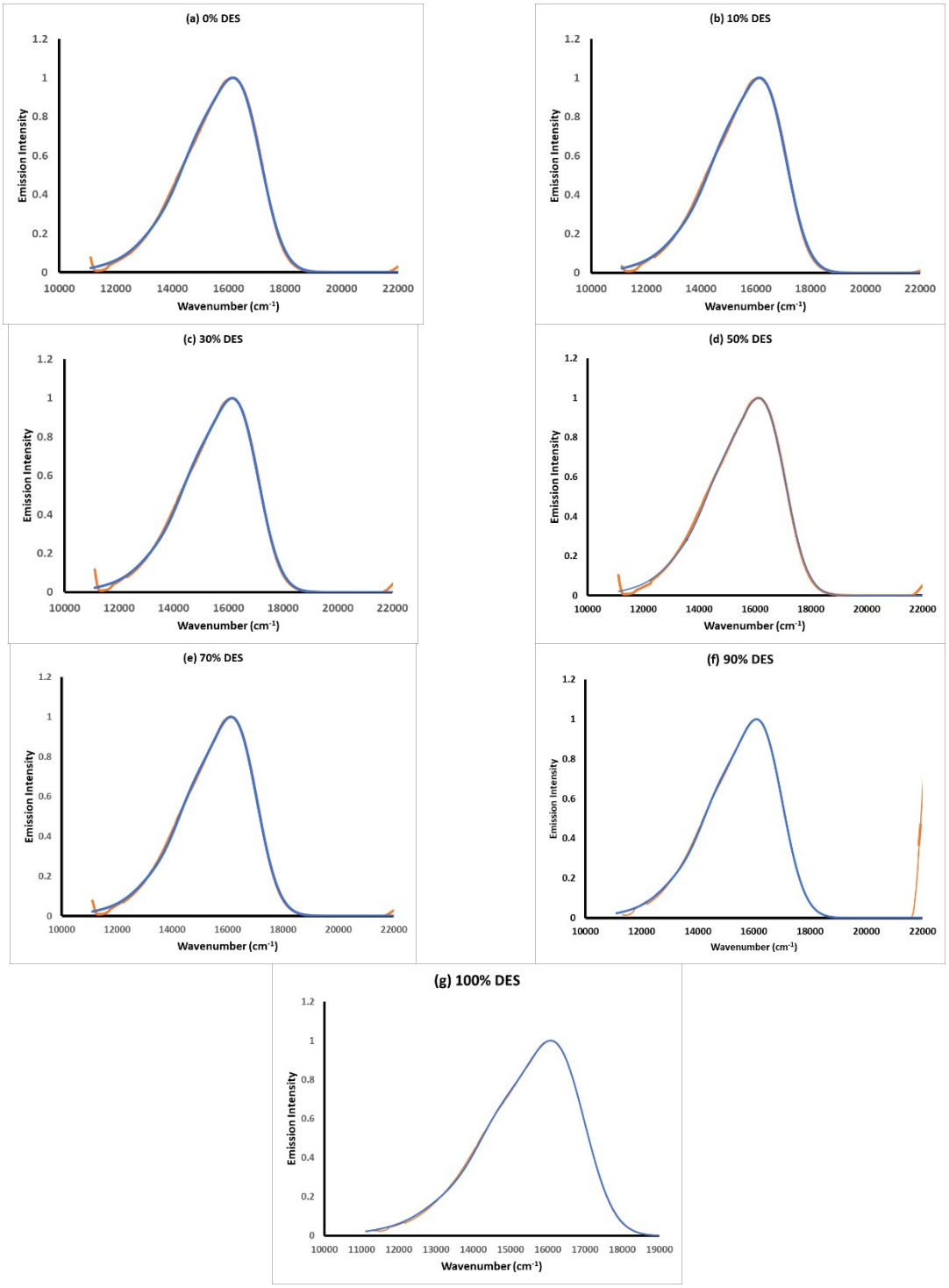

Fig. S8. Emission spectral fitting (blue = calculated; orange = corrected) of tris(2,2'-bipyridine) ruthenium (II) hexafluorophosphate $[Ru(bpy)_3]^{2+}$ in (a) 0% DES, (b)10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES mixture.

4. Electrochemical data for $[Ru(bpy)_3]^{2+}$ and quenchers

Table S2. Redox ($E_{1/2}$) potentials (V) of $[Ru(bpy)_3]^{2+}$ and all the quenchers used vs Ag/AgCl.

DES	$[Ru(bpy)_3]^{2+}$	DPV	BV	MV	DHB	DMPP-DB	EV	*THDDP-DB*	DMDHP-DB	*TMBP-I_2*
0	1.114	-0.36	-0.46	-0.56	-0.59	-0.69	-0.71	-0.90	-0.86	-0.95
10	1.114	-0.36	-0.53	-0.63	-0.47	-0.69	-0.62	-0.92	-0.87	-0.95
30	1.114	-0.35	-0.46	-0.62	-0.44	-0.69	-0.61	-0.92	-0.87	-0.97
50	1.114	-0.34	-0.46	-0.58	-0.43	-0.66	-0.58	-0.92	-0.87	-0.97
70	1.114	-0.34	-0.46	-0.54	-0.41	-0.63	-0.56	-0.91	-0.79	-0.96
90	1.114	-0.26	-0.42	-0.51	-0.40	-0.58	-0.51	-0.90	-0.86	-0.93
100	1.114	-0.26	-0.41	-0.48	-0.38	-0.55	-0.48	-0.89	-0.71	-0.92

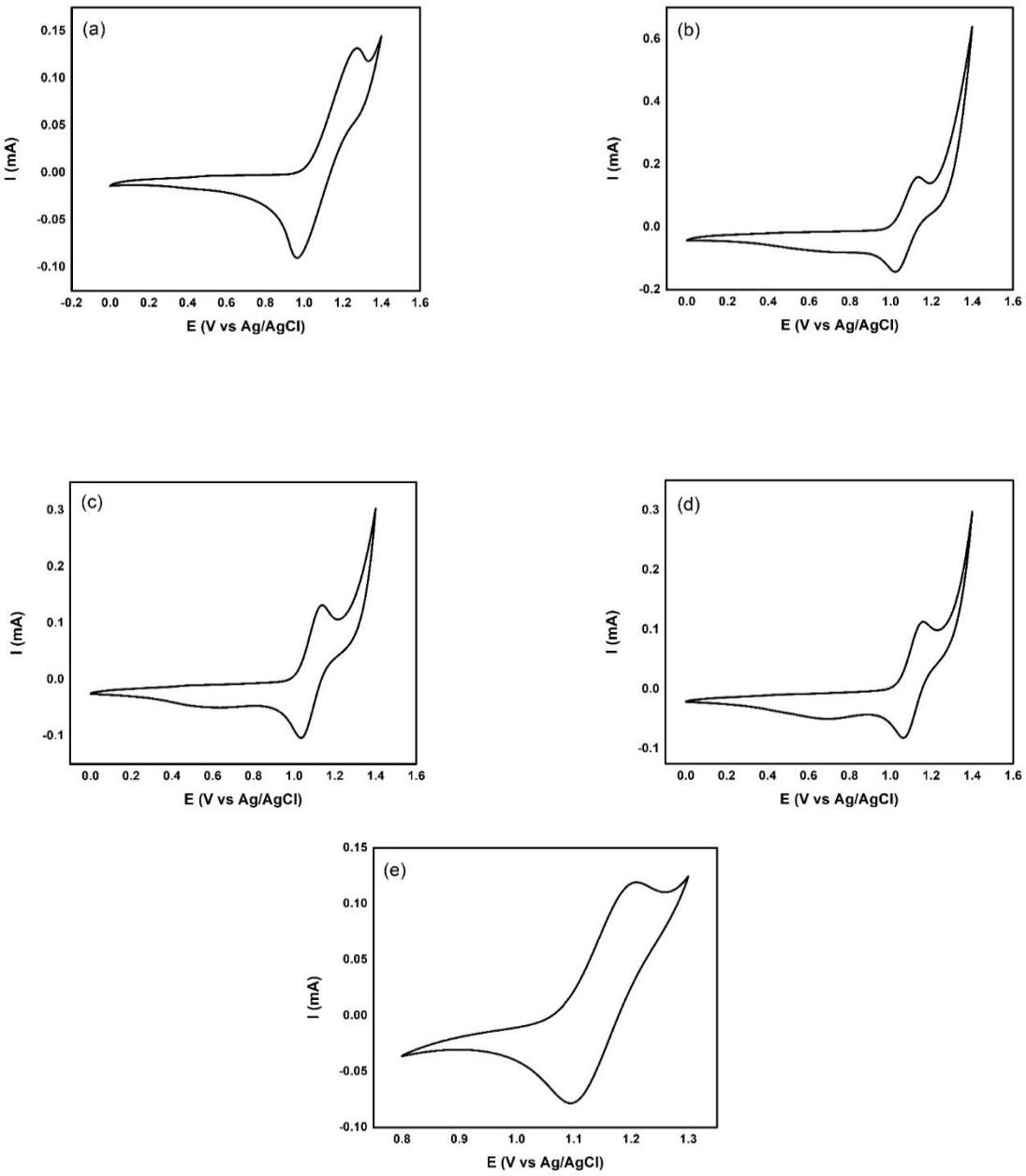

Fig. S9. Cyclic voltammetry plots of Tris(2,2′-bipyridyl)dichlororuthenium(II) hexahydrate $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, and (e) 70% DES mixture.

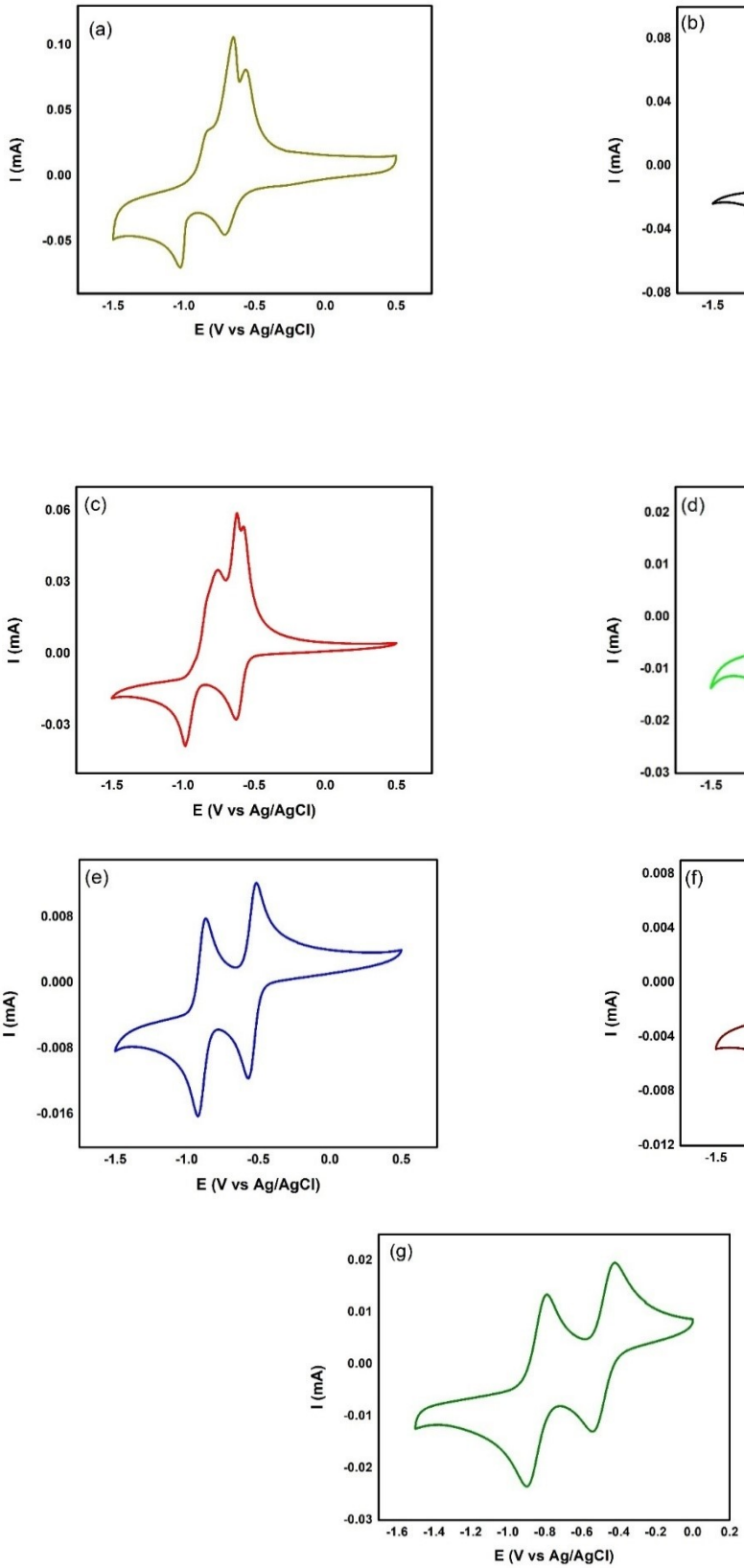

Fig. S10. Cyclic voltammetry plots of methyl viologen dichloride hydrate (MV) in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES mixture.

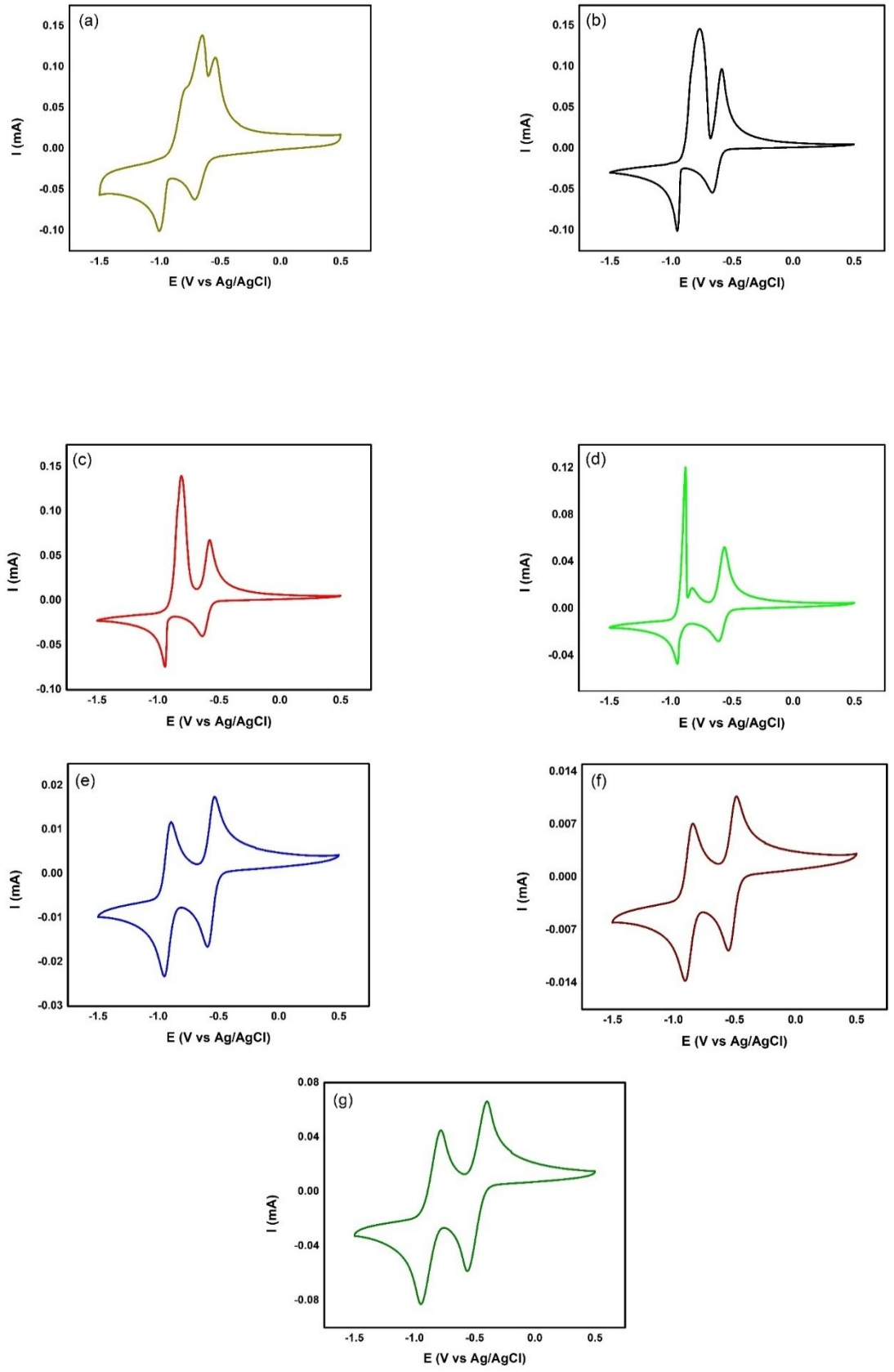

Fig. S11. Cyclic voltammetry plots of ethyl viologen dibromide (EV) in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES mixture.

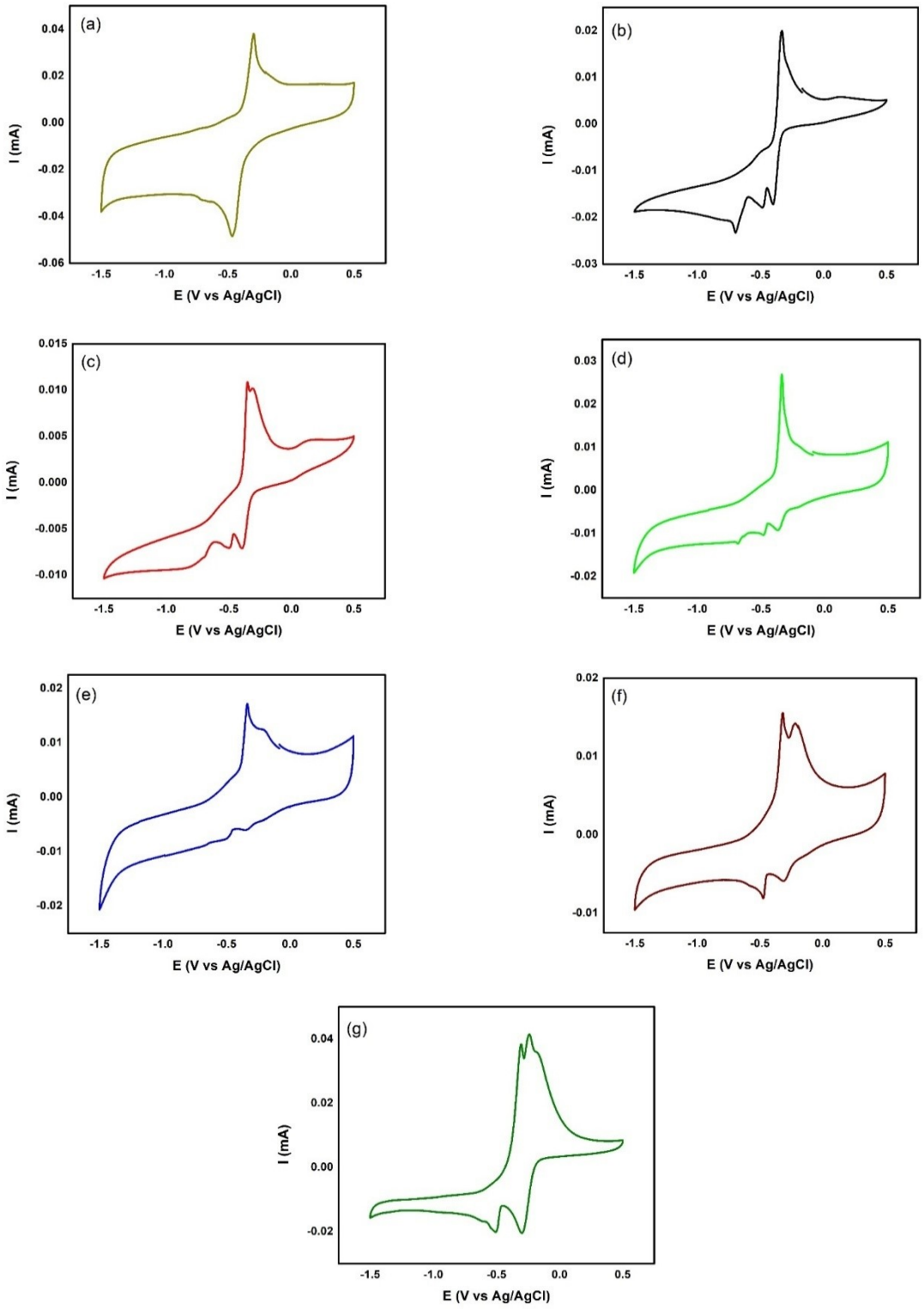

Fig. S12. Cyclic voltammetry plots of 1,1'-Diphenyl-[4,4'-bipyridine]-1,1'-diium chloride (DPV) in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES mixture.

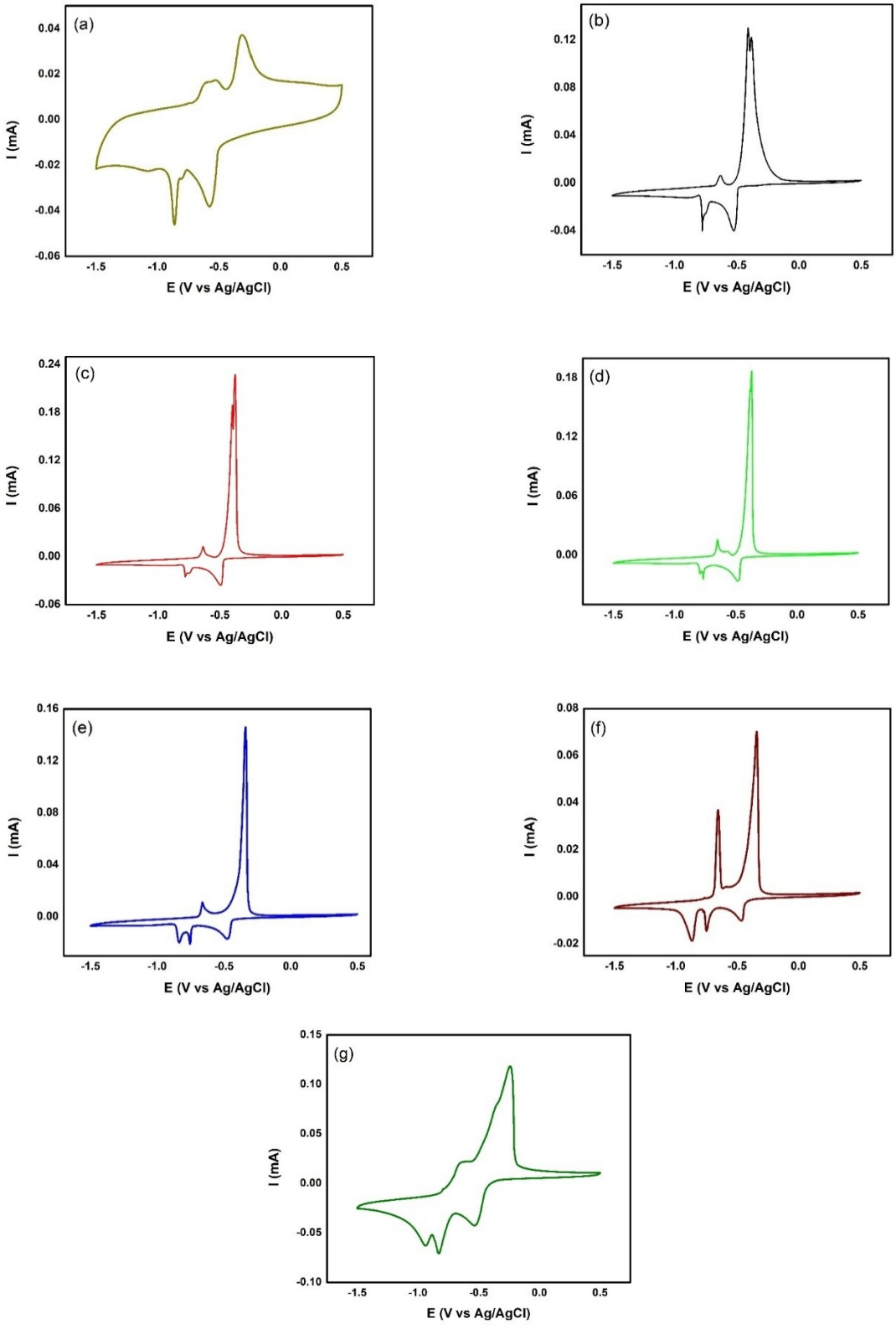

Fig. S13. Cyclic voltammetry plots of 1,1'-Diheptyl-4,4'-bipyridinium Dibromide (DHB) in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES mixture.

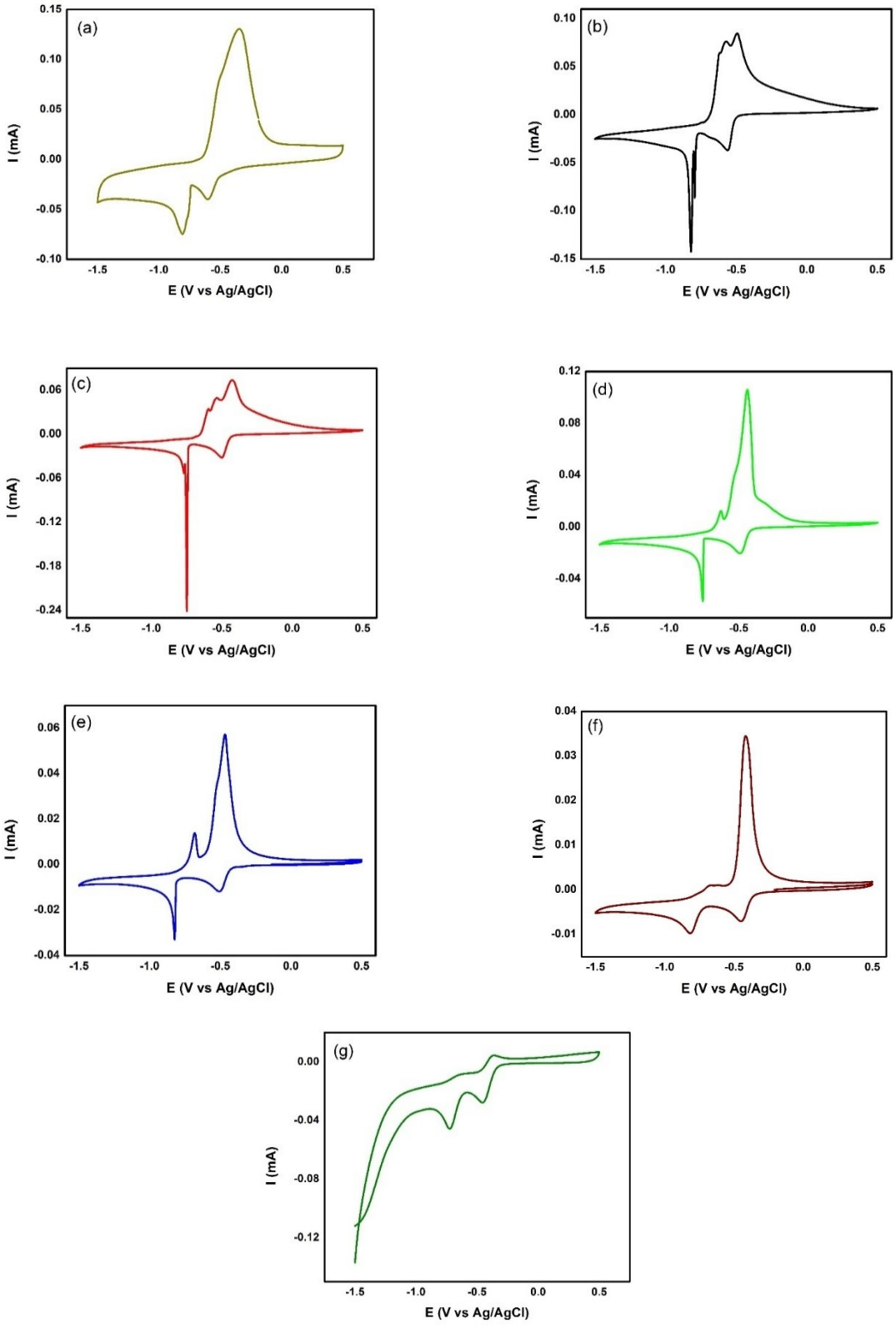

Fig. S14. Cyclic voltammetry plots of benzyl viologen dichloride (BV) in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES mixture.

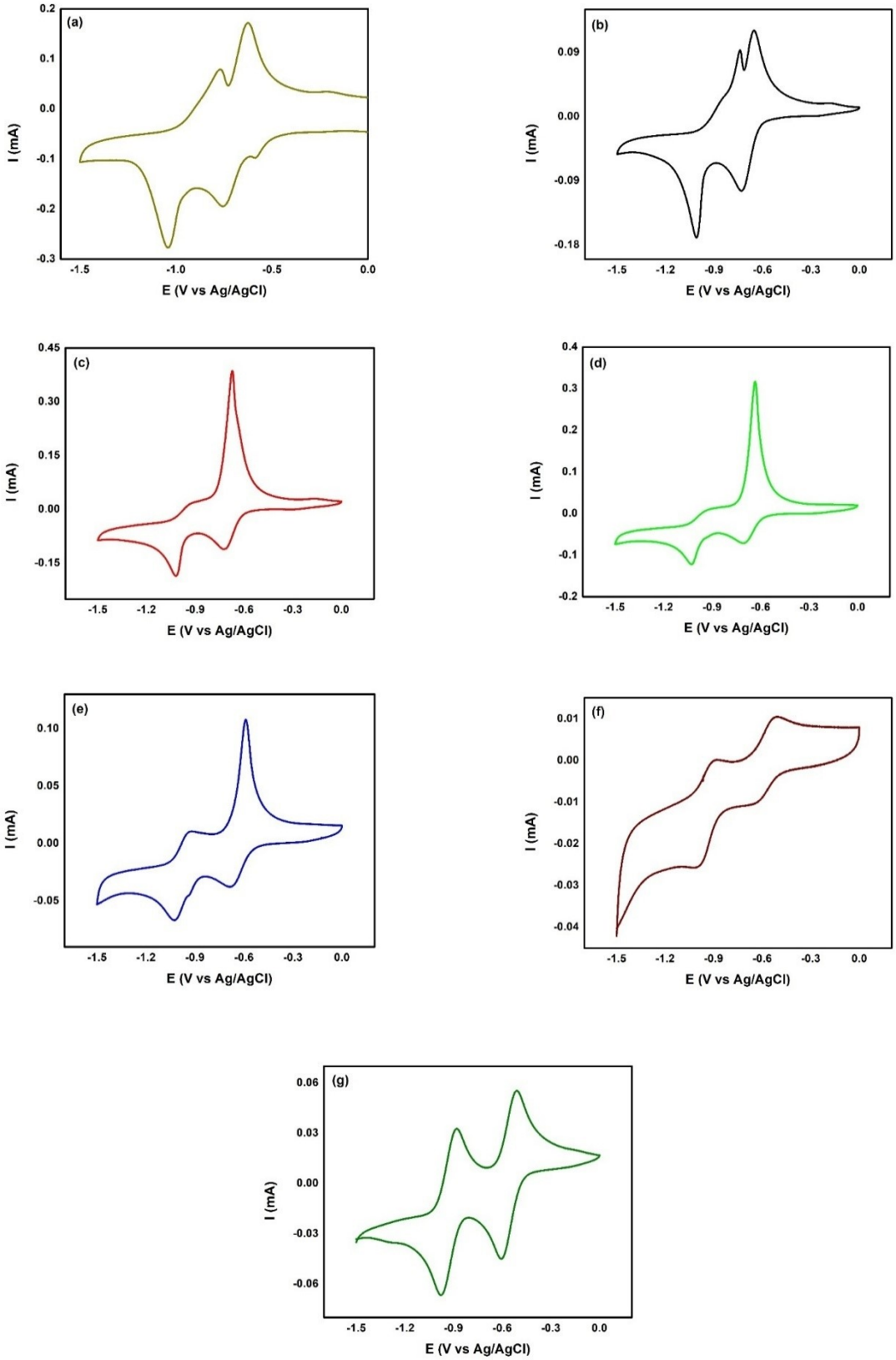

Fig. S15. Cyclic voltammetry plots of 2,11-Dimethyl-6,7-dihydrodipyrido[1,2-a:2′,1′-c]pyrazinediium dibromide (DMPP-DB) in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES mixture.

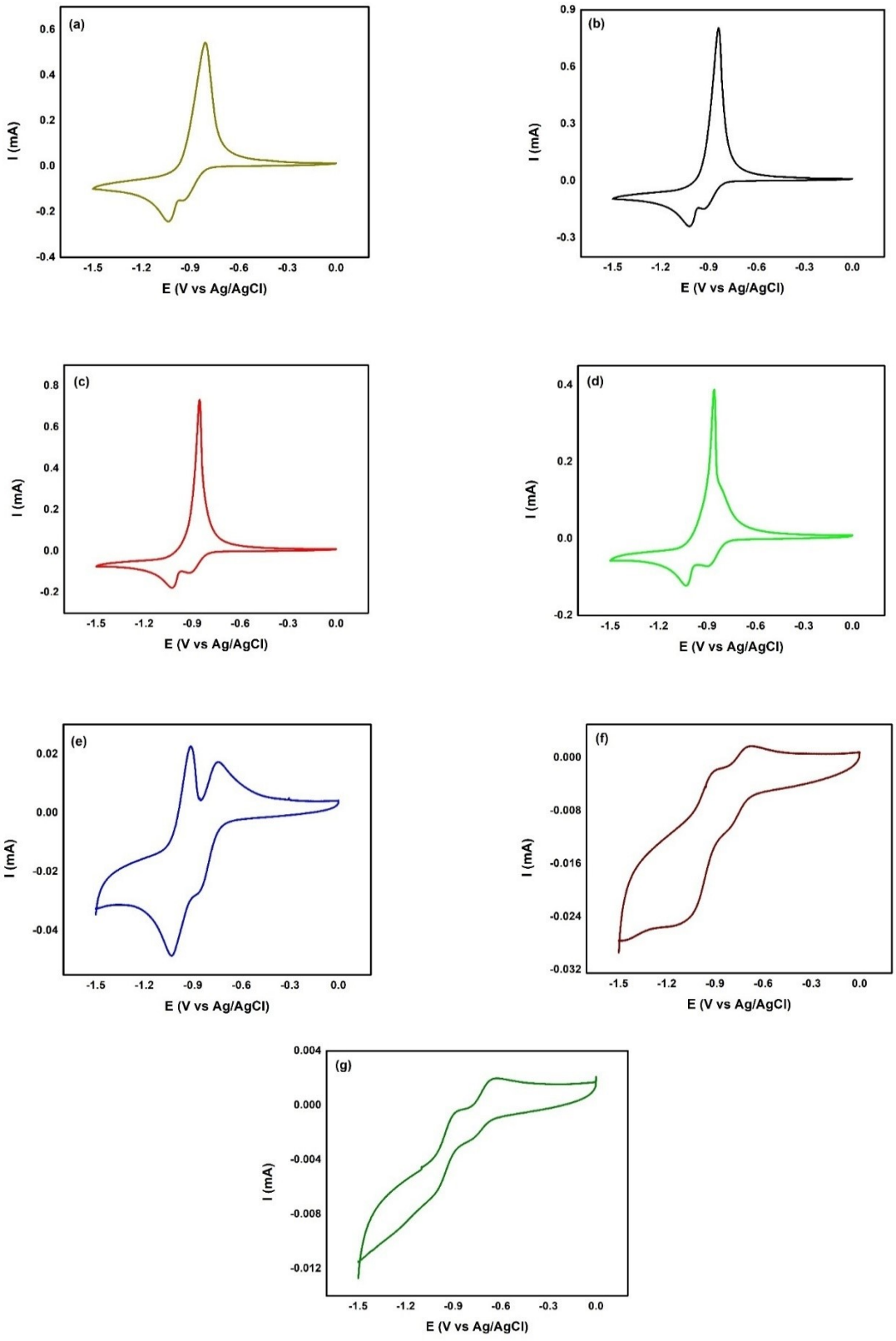

Fig. S16. Cyclic voltammetry plots of 2,12- Dimethyl-7,8-dihydro-6Ff-dipyrido[l,2-a :2',l'-c]-[l,4]diazepinium Dibromide (DMDHP-DB) in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES mixture.

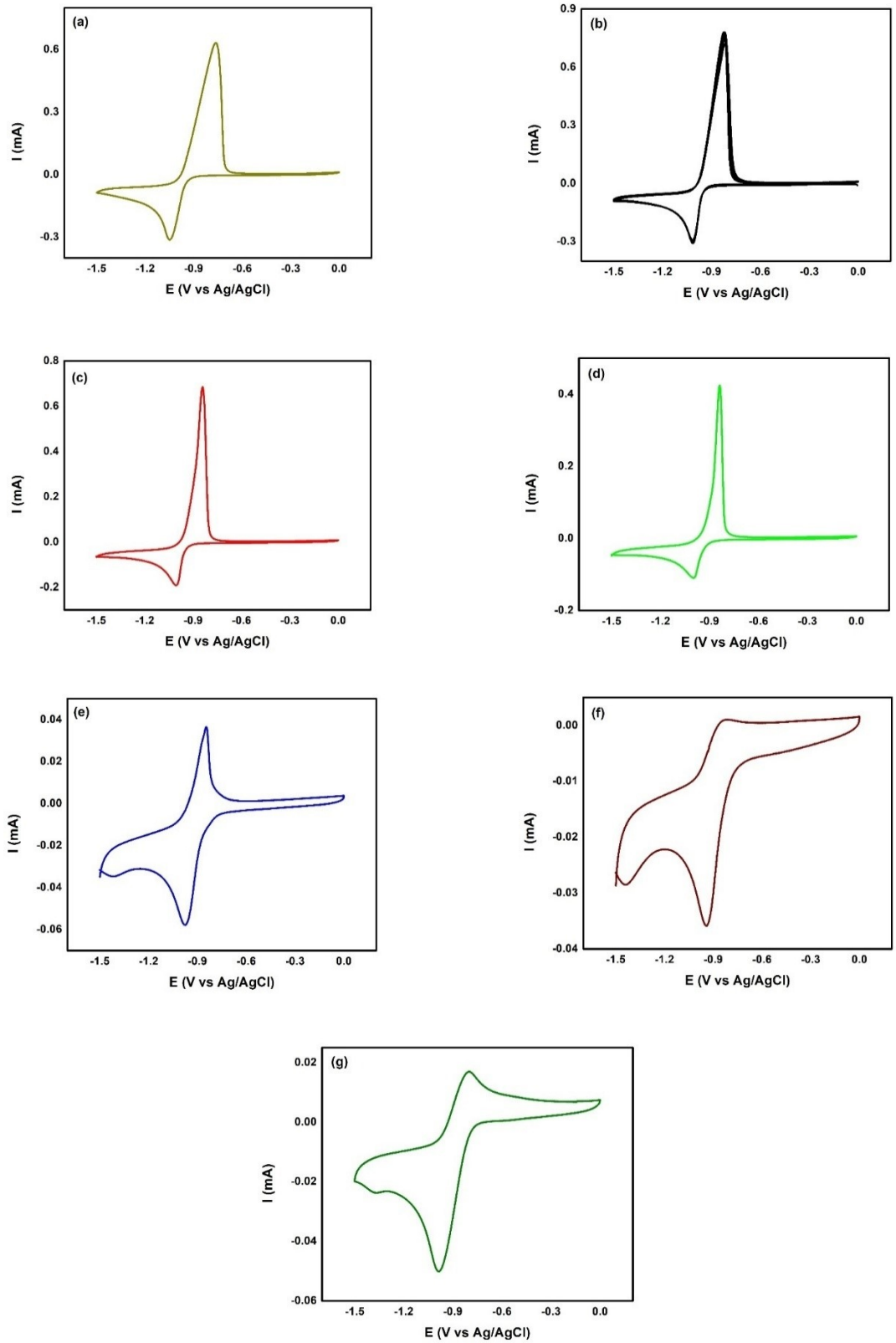

Fig. S17. Cyclic voltammetry plots of 6,7,8,9-tetrahydro-2,13-dimethyldipyrido<1,2-a:2',1'-c><1,4>diazocinediium dibromide (THDDP-DB) in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES mixture.

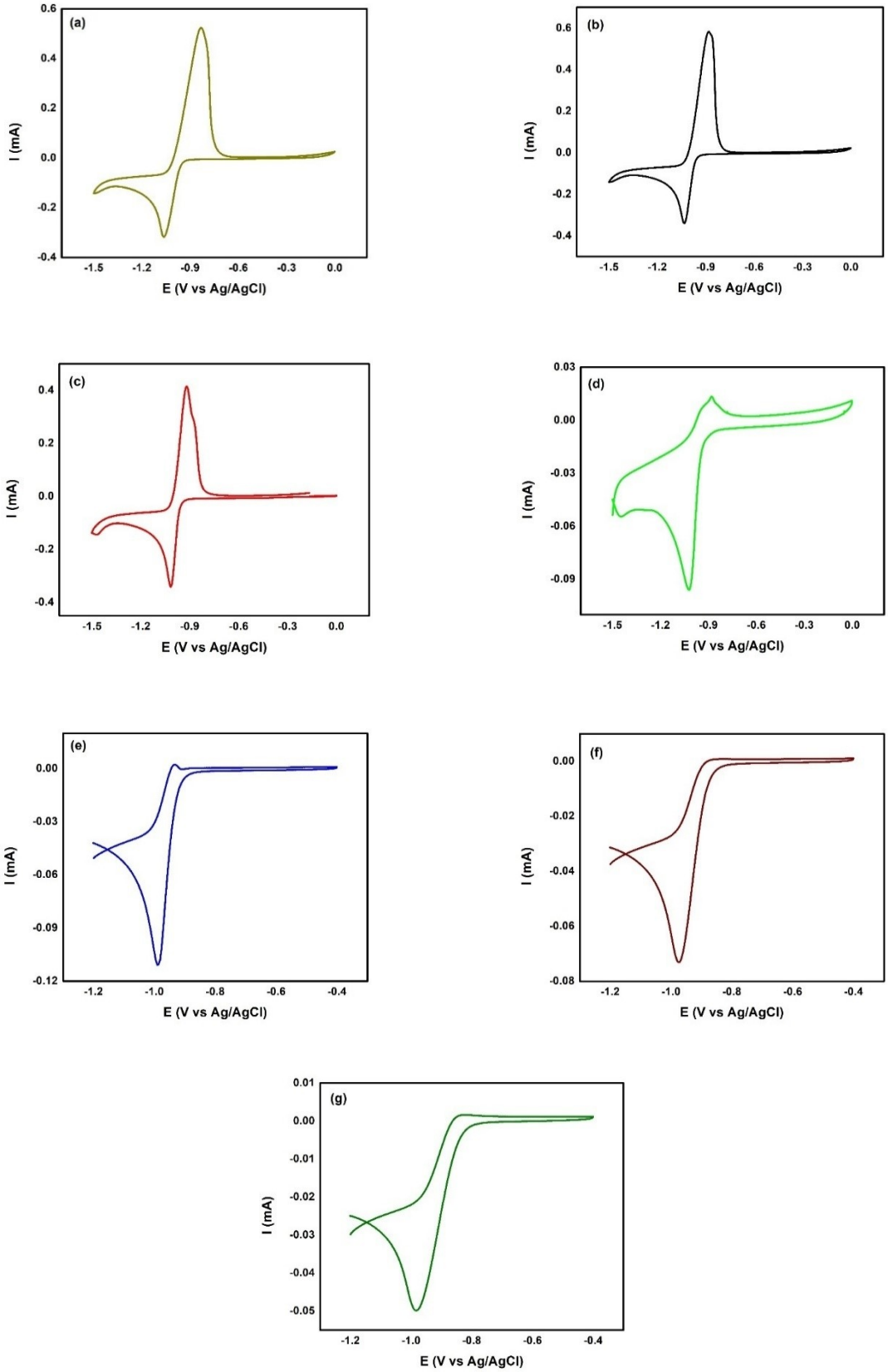

Fig. S18. Cyclic voltammetry plots of 1,1',4,4'-Tetramethyl-2,2'-bipyridinium diiodide (TMBP-I_2) in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES mixture.

5. Electron Transfer Data

Table S3. The free energy (ΔG_{ET} (kcal/mol)) of electron transfer between $[Ru(bpy)_3]^{2+}$ and series of quenchers in all DES mixtures using Rehm-Weller analysis.

DES %	MV	BV	EV	DPV	DHB	DMPP-DB	DMDHP-DB	THDDP-DB	TMBP-I_2
0	-7.64	-10.16	-7.77	-13.33	-10.79	-8.10	-4.18	-3.26	-2.10
10	-8.77	-11.11	-8.78	-14.92	-11.95	-8.10	-3.95	-2.80	-2.10
30	-9.62	-12.56	-9.38	-15.02	-12.69	-8.10	-3.95	-2.80	-1.64
50	-9.34	-11.96	-9.20	-14.92	-12.14	-7.99	-3.15	-2.00	-0.84
70	-9.49	-11.36	-9.03	-14.82	-11.73	-8.08	-4.39	-1.63	-0.47
90	-9.63	-11.74	-9.38	-14.76	-12.77	-8.64	-2.18	-1.26	-0.57
100	-10.94	-12.56	-10.94	-16.02	-13.25	-9.33	-5.64	-1.49	-0.80

5.1 The free energy (ΔG) calculation from Marcus analysis

$$k_q = k_q^0 e^{\left(\frac{-\Delta G^{\ddagger}}{RT}\right)} \qquad (S2a)$$

$$\Delta G^{\ddagger} = \frac{\lambda}{4}\left((1 + \frac{\Delta G_0}{\lambda})^2\right) \qquad (S2b)$$

Here k_q^0 is the pre-exponential factor (maximum quenching rate when $\Delta G_0 = -\lambda$), λ is reorganization energy, ΔG_0 is free energy change and $\Delta G^{\ddagger}$ is the activation barrier for electron transfer.[1] The calculated ΔG values for electron transfer between RuBpy-quenchers in all ethaline mixtures is given in Table S4 below. The plot between ln k_q vs ΔG were used to derive k_q^0 and λ, and the data is listed in Table S5 below.

Table S4. The free energy ($\Delta G_{ET}(eV)$) of electron transfer between $[Ru(bpy)_3]^{2+}$ and series of quenchers in all DES mixtures using Marcus analysis.

DES%	BV	MV	DHB	EV	DPV	THDDP-DB	DMDHP-DB	TMBP-I_2	DMPP-DB
0	-0.319	-0.210	-0.346	-0.216	-0.457	-0.020	-0.060	0.030	-0.230
10	-0.357	-0.256	-0.393	-0.256	-0.522	0.004	-0.046	0.034	-0.226
30	-0.418	-0.290	-0.423	-0.279	-0.524	0.006	-0.044	0.056	-0.224
50	-0.424	-0.311	-0.432	-0.305	-0.553	0.008	-0.042	0.058	-0.252
70	-0.422	-0.341	-0.438	-0.321	-0.572	0.001	-0.119	0.051	-0.279
90	-0.460	-0.368	-0.504	-0.357	-0.591	-0.005	-0.045	0.025	-0.325
100	-0.500	-0.430	-0.530	-0.430	-0.650	-0.020	-0.200	0.010	-0.360

Table S5. Electron transfer parameters derived from Marcus plots.

DES%	λ (eV)	λ (kcal/mol)	$K_q^0 \times 10^8$ (L mol^{-1} s^{-1})
0	0.44	10.146	1.30
10	0.44	10.146	1.20
30	0.43	9.916	1.20
50	0.40	9.224	0.90
70	0.45	10.377	0.30
90	0.44	10.146	0.31
100	0.44	10.146	0.060

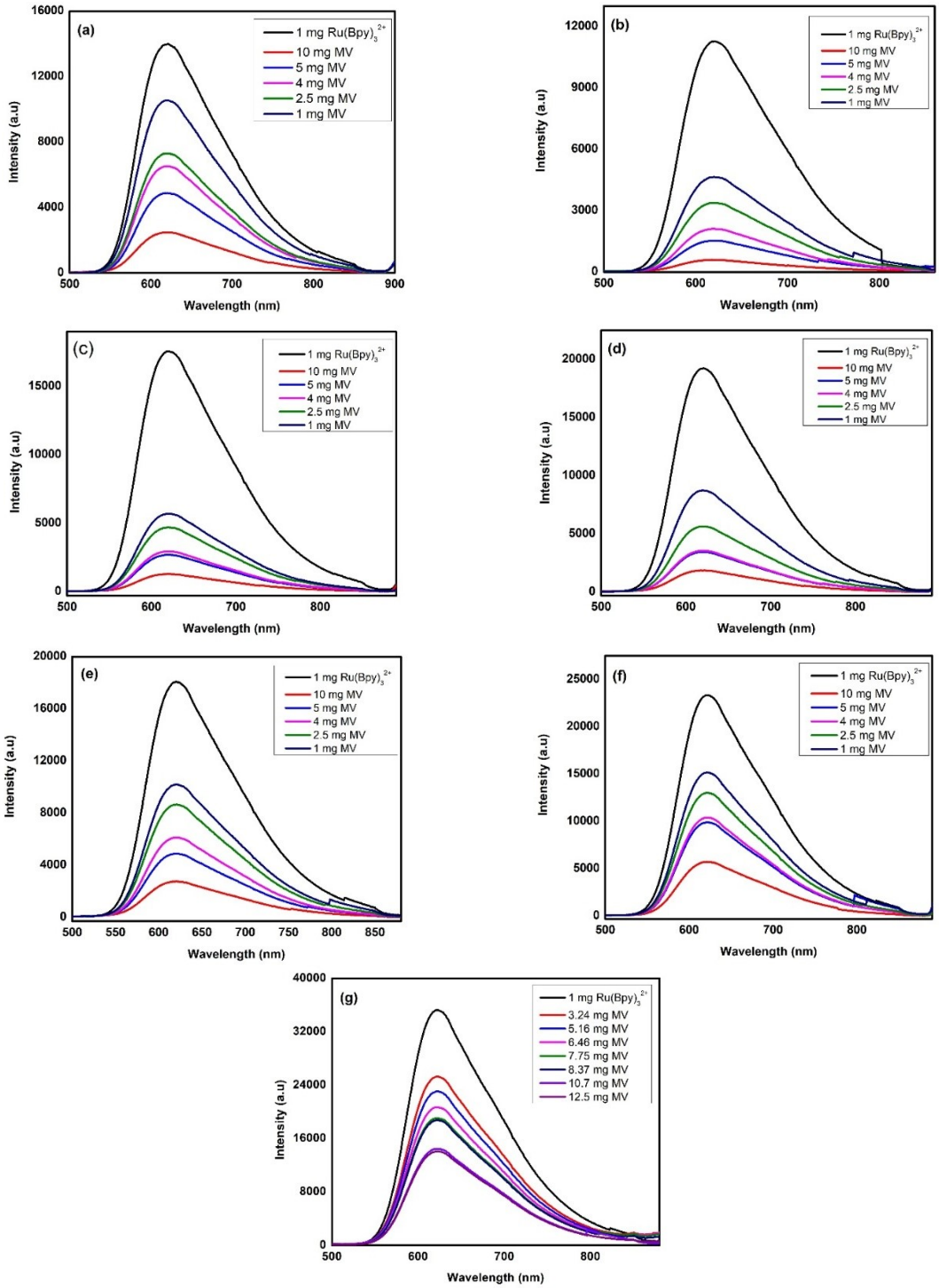

Fig. S19. Fluorescence emission spectra ($\lambda_{excitation}$ = 452 nm) of methyl viologen dichloride hydrate (MV) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture and (f) 90% DES mixture (g) 100% DES mixture.

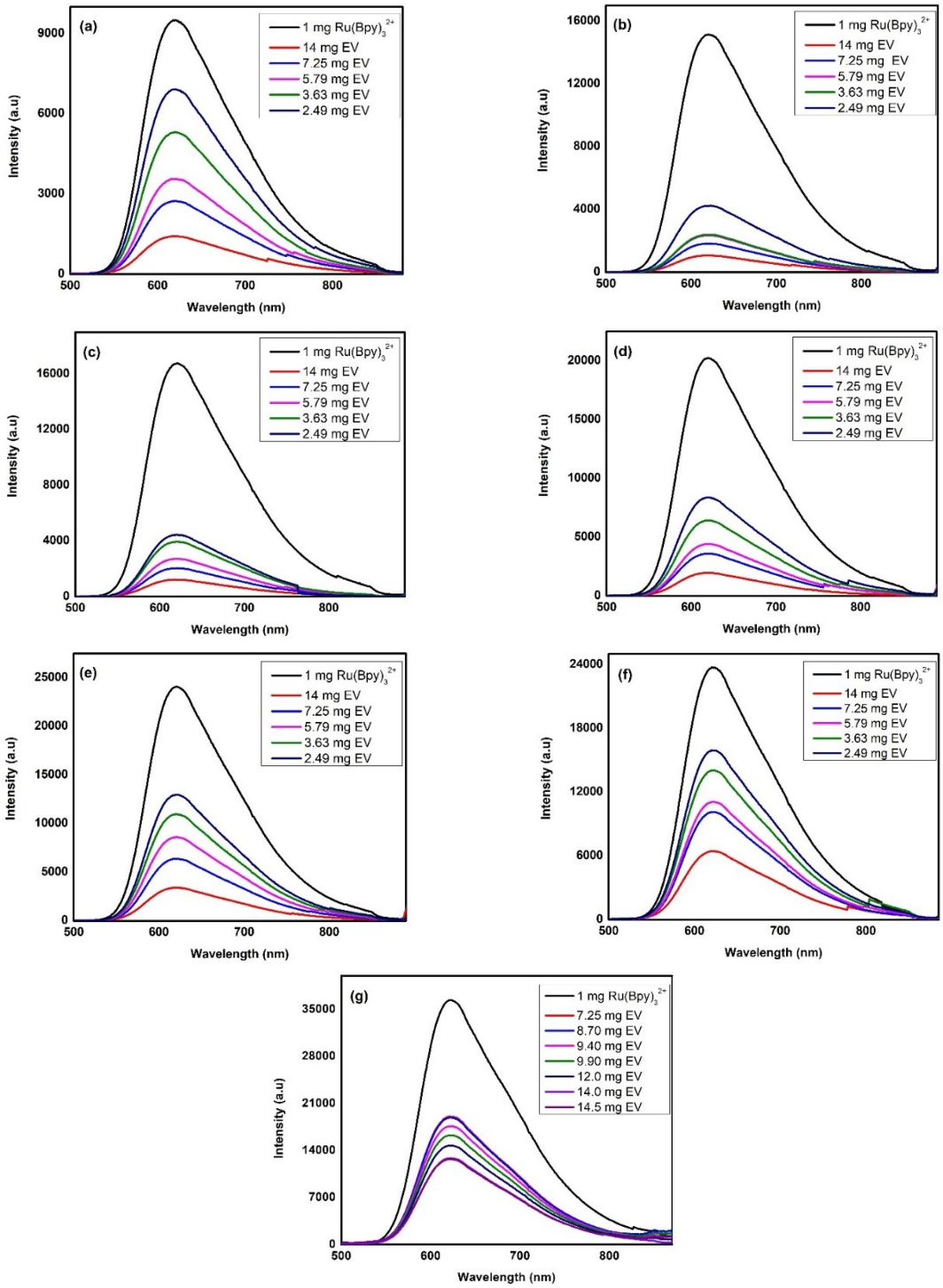

Fig. S20. Fluorescence emission spectra ($\lambda_{excitation}$ = 452 nm) of ethyl viologen dibromide (EV) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture and (f) 90% DES mixture (g) 100% DES mixture.

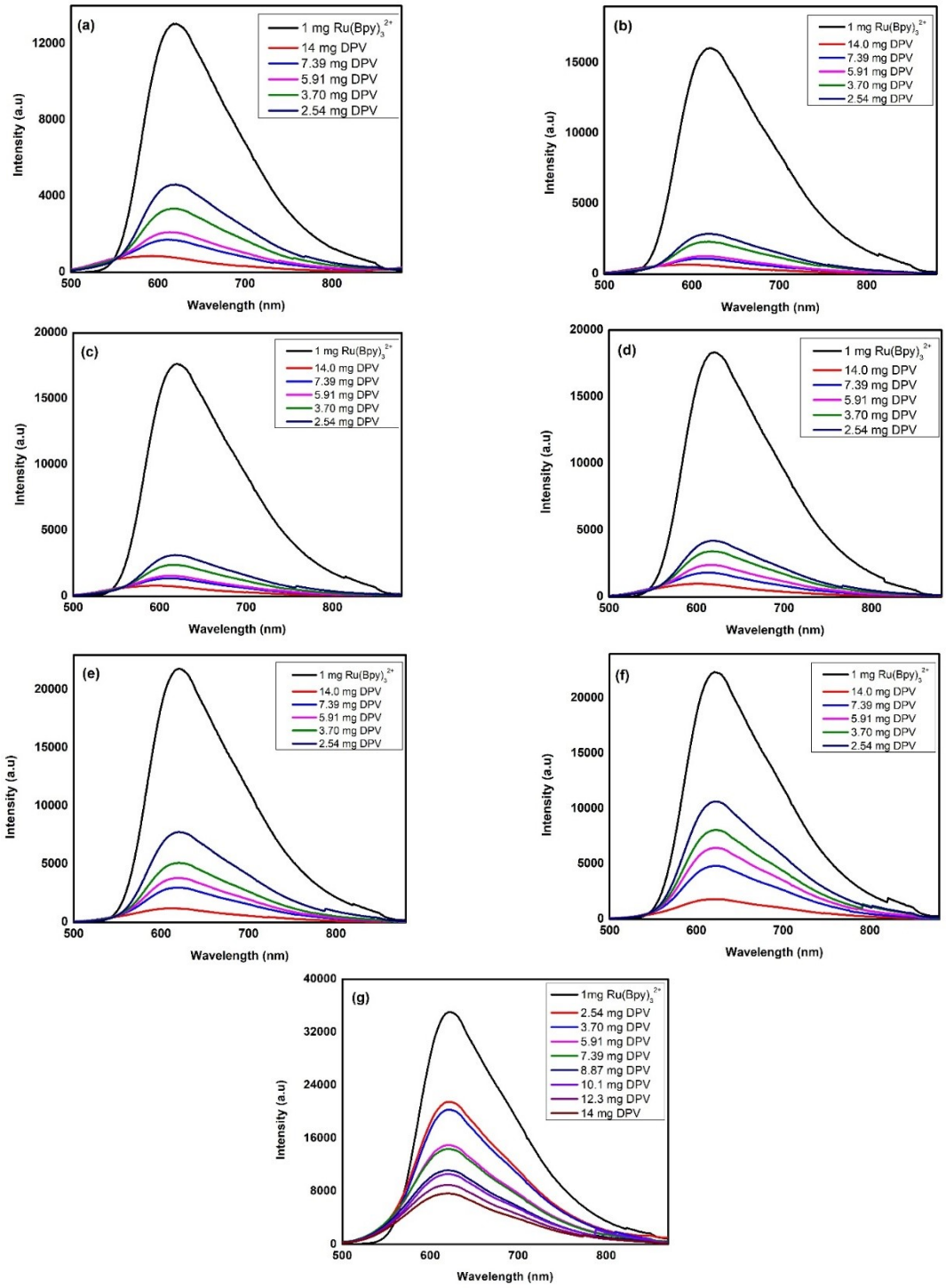

Fig. S21. Fluorescence emission spectra ($\lambda_{excitation}$ = 452 nm) of 1,1'-Diphenyl-[4,4'-bipyridine]-1,1'-diium chloride (DPV) in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture and (f) 90% DES mixture (g) 100% DES mixture.

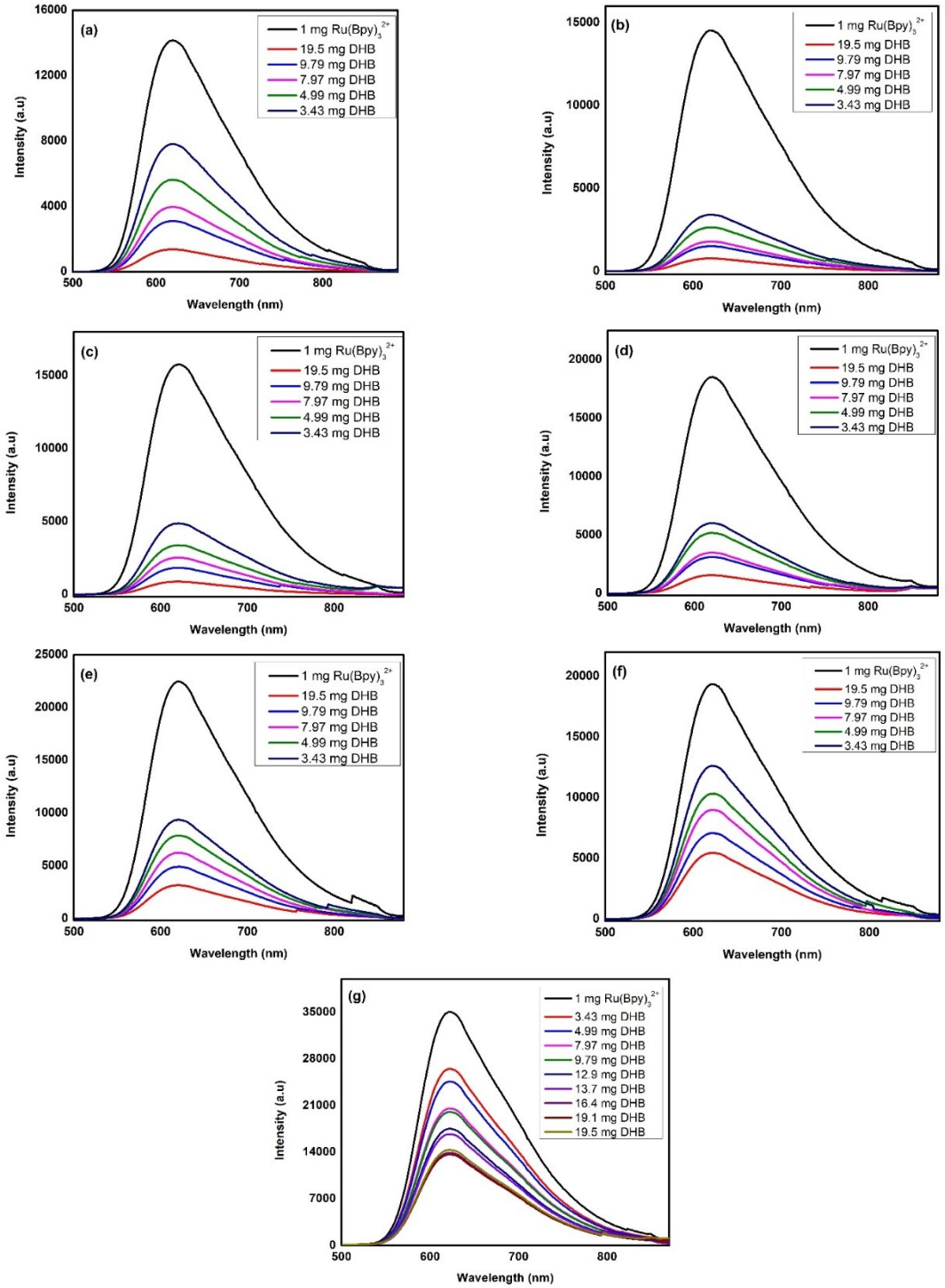

Fig. S22. Fluorescence emission spectra ($\lambda_{excitation}$ = 452 nm) of 1,1'-Diheptyl-4,4'-bipyridinium Dibromide (DHB) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture and (f) 90% DES mixture (g) 100% DES mixture.

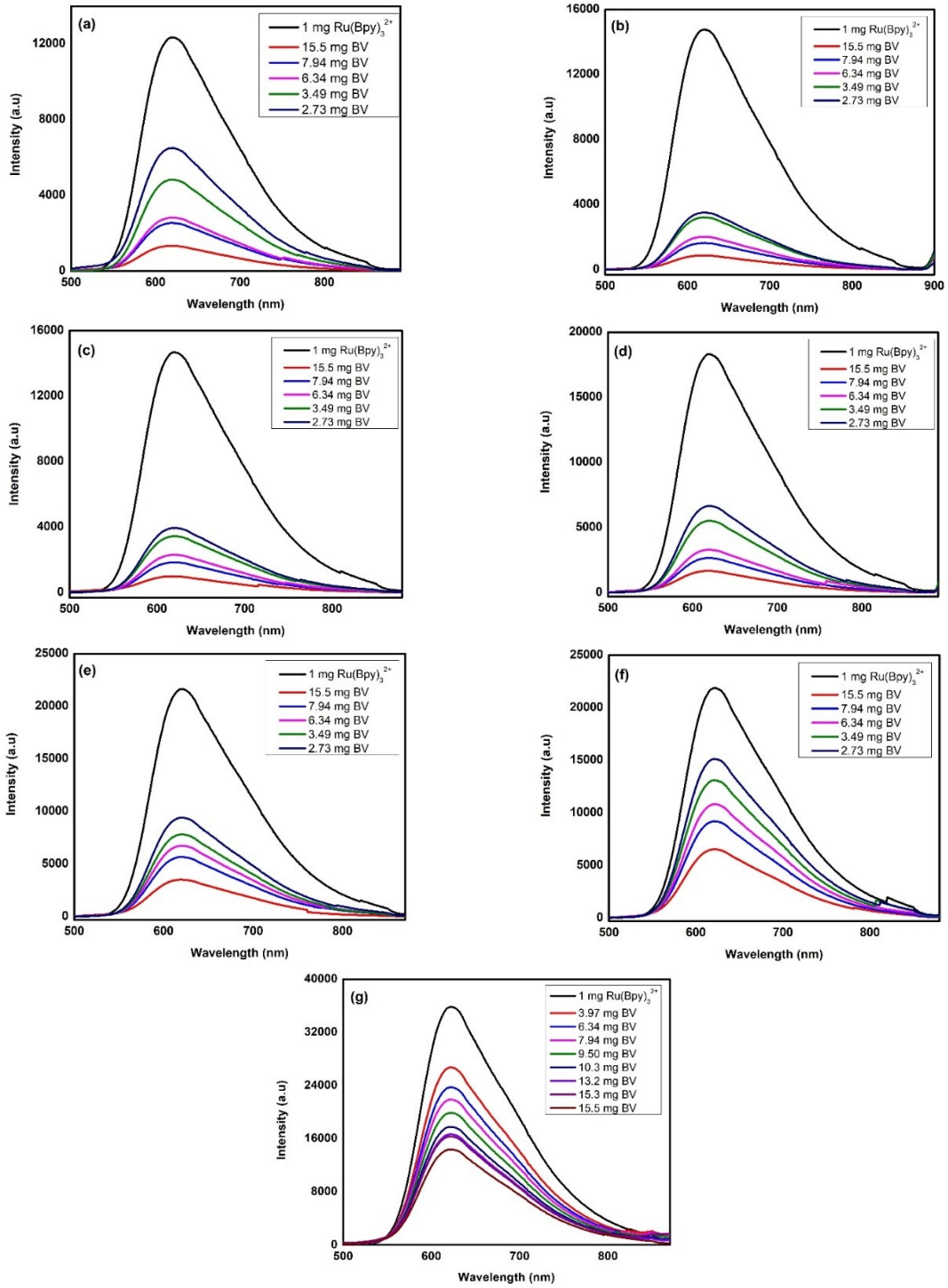

Fig. S23. Fluorescence emission spectra (λexcitation = 452 nm) of benzyl viologen dichloride (BV) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture and (f) 90% DES mixture (g) 100% DES mixture.

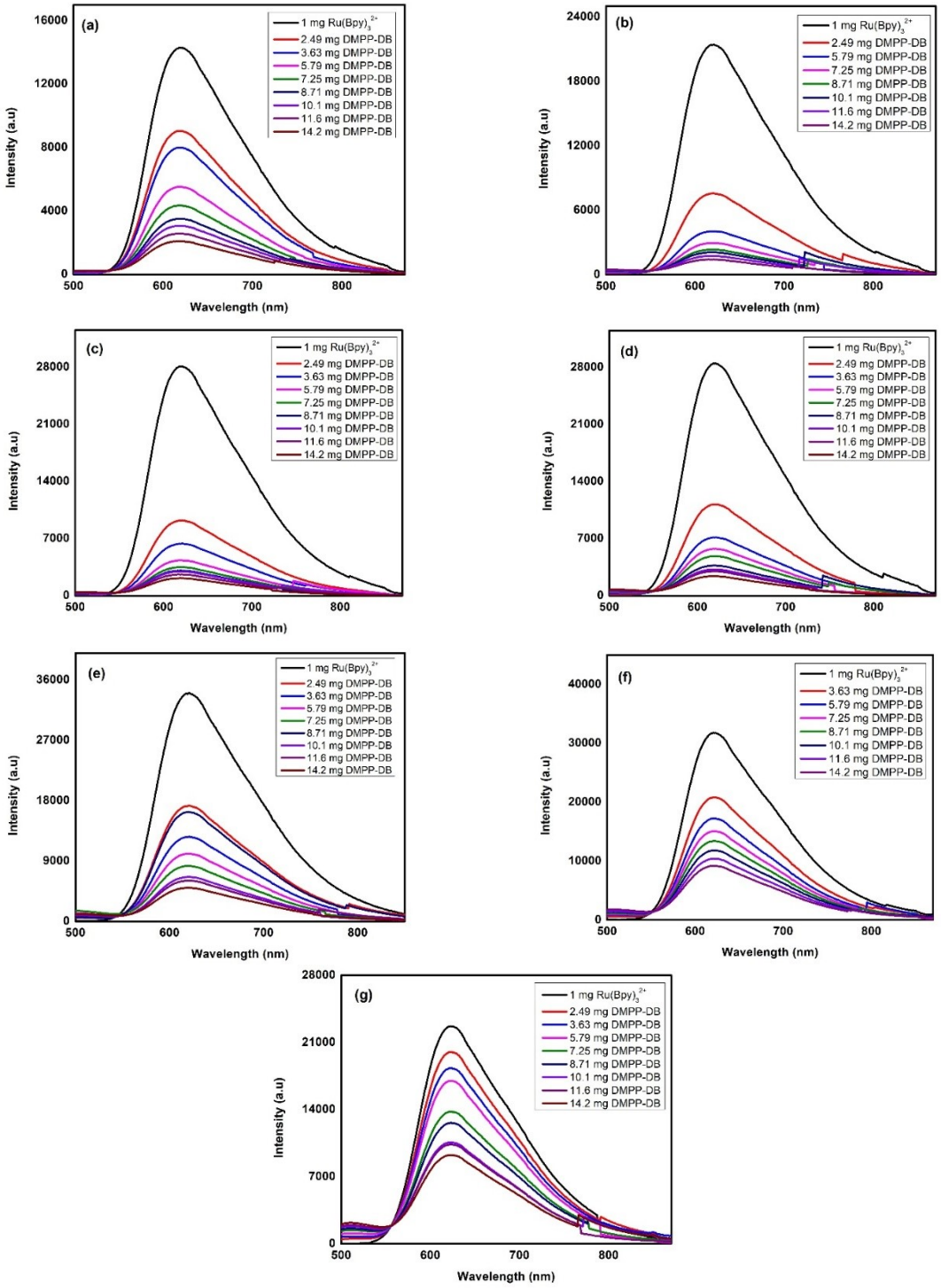

Fig. S24. Fluorescence emission spectra ($\lambda_{excitation}$ = 452 nm) of 2,11-Dimethyl-6,7-dihydrodipyrido[1,2-a:2′,1′-c]pyrazinediium dibromide (DMPP-DB) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture and (f) 90% DES mixture (g) 100% DES mixture.

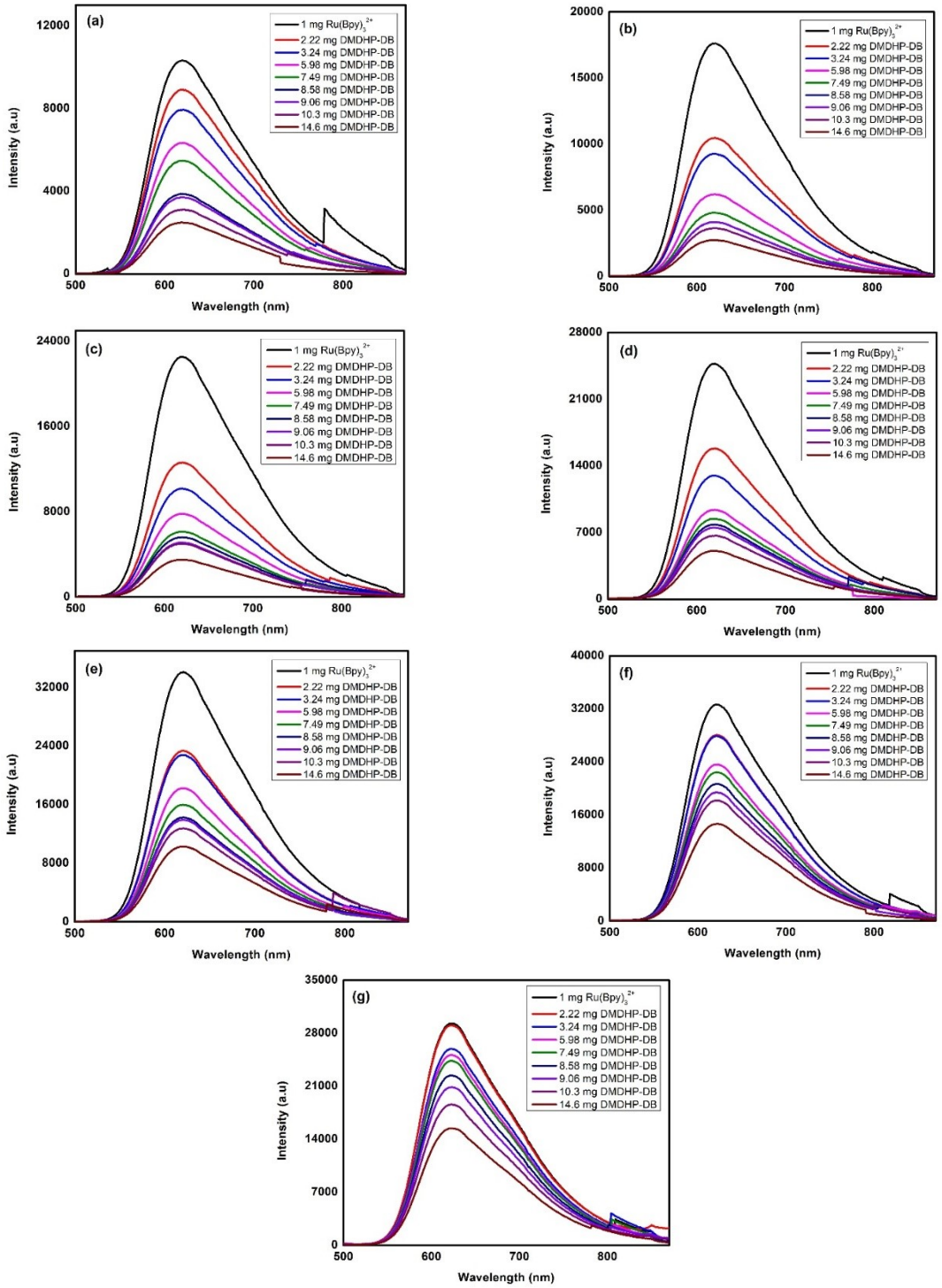

Fig. S25. Fluorescence emission spectra ($\lambda_{excitation}$ = 452 nm) of 2,12- Dimethyl-7,8-dihydro-6Ff-dipyrido[l,2-a :2',l'-c]-[l,4]diazepinium Dibromide (DMDHP-DB) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture and (f) 90% DES mixture (g) 100% DES mixture.

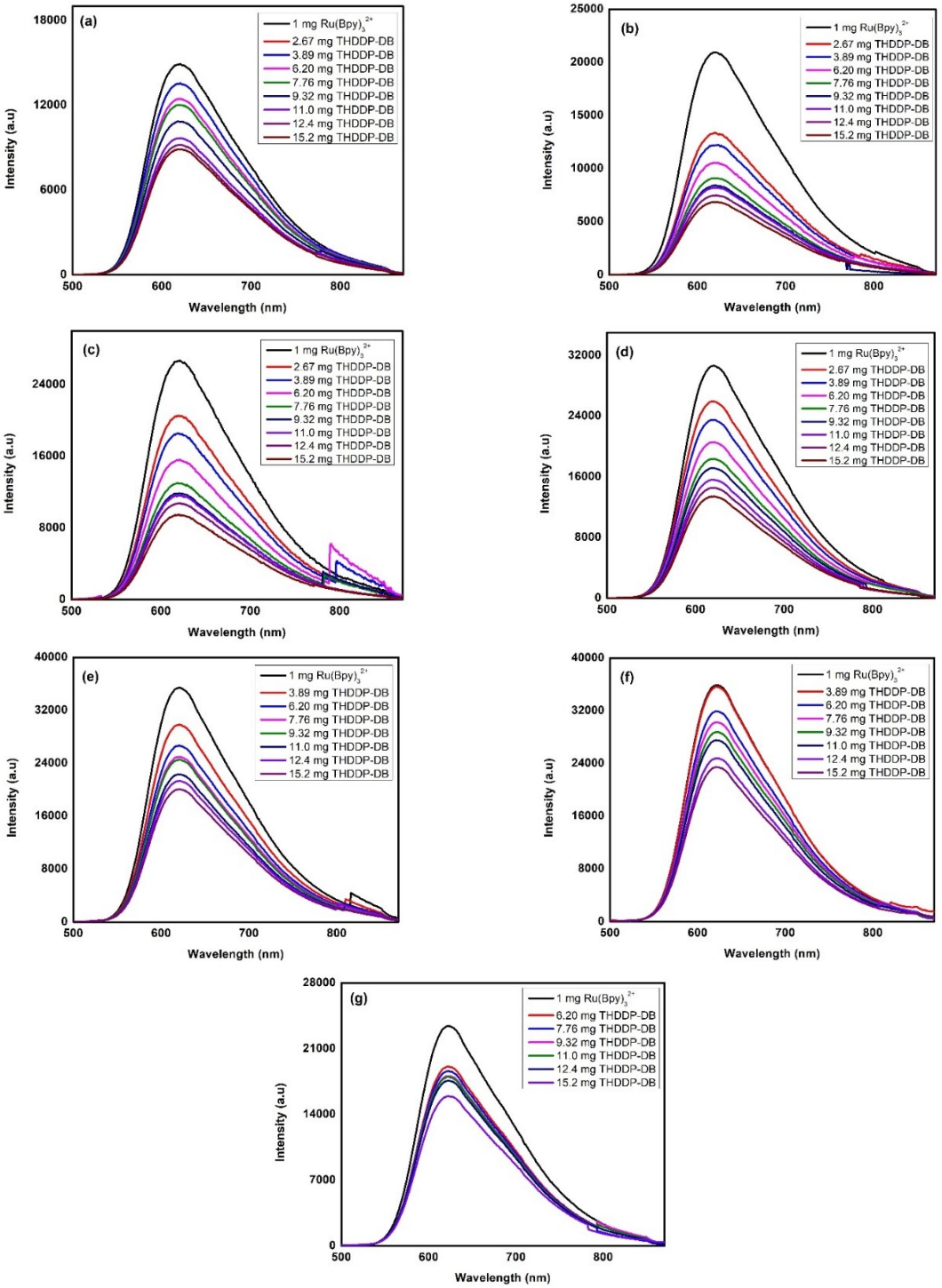

Fig. S26. Fluorescence emission spectra ($\lambda_{excitation}$ = 452 nm) of 6,7,8,9-tetrahydro-2,13-dimethyldipyrido<1,2-a:2',1'-c><1,4>diazocinediium dibromide (THDDP-DB) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture and (f) 90% DES mixture (g) 100% DES mixture.

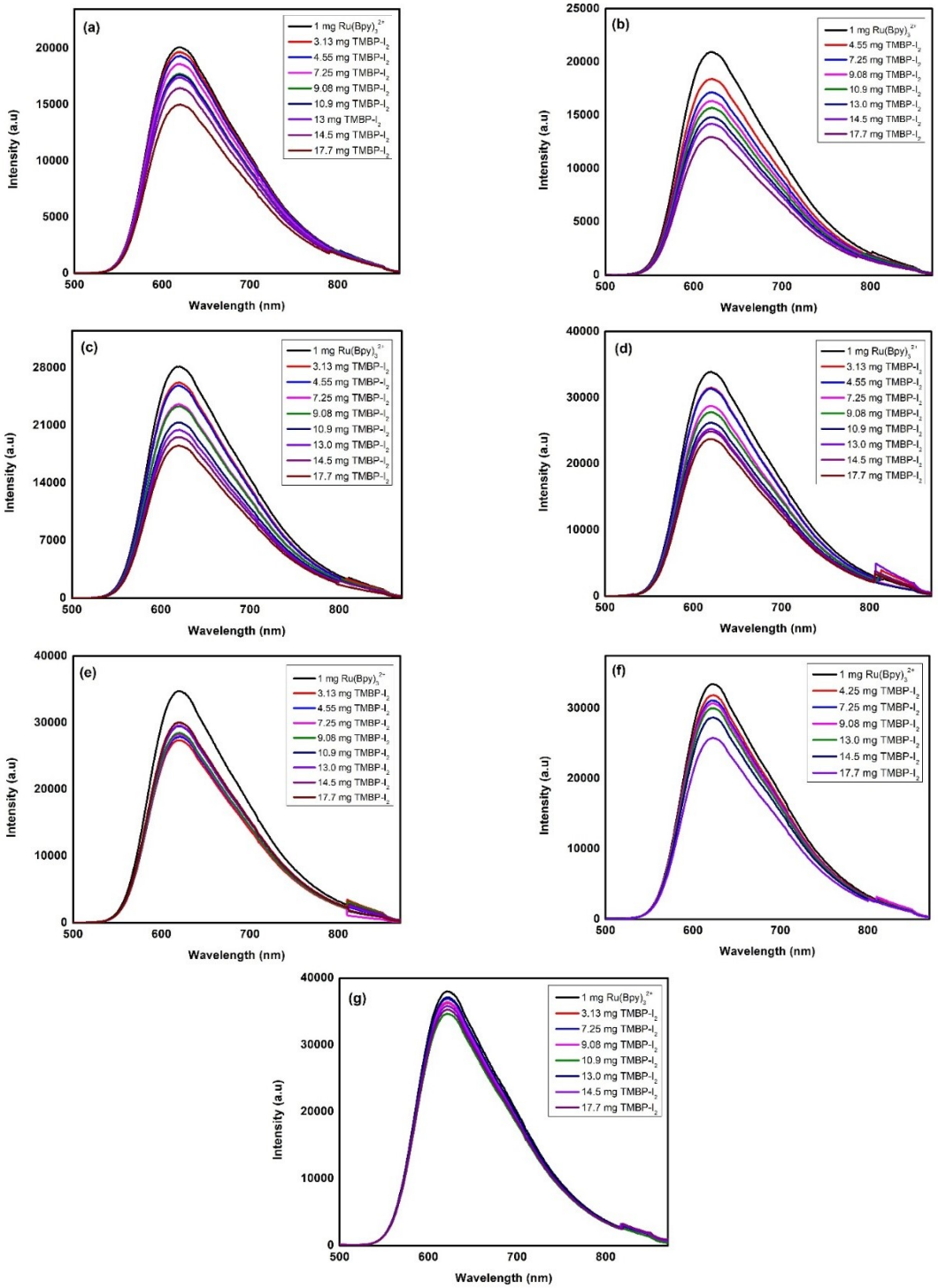

Fig. S27. Fluorescence emission spectra ($\lambda_{excitation}$ = 452 nm) of 1,1′,4,4′-Tetramethyl-2,2′-bipyridinium diiodide (TMBP-I_2) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture and (f) 90% DES mixture (g) 100% DES mixture.

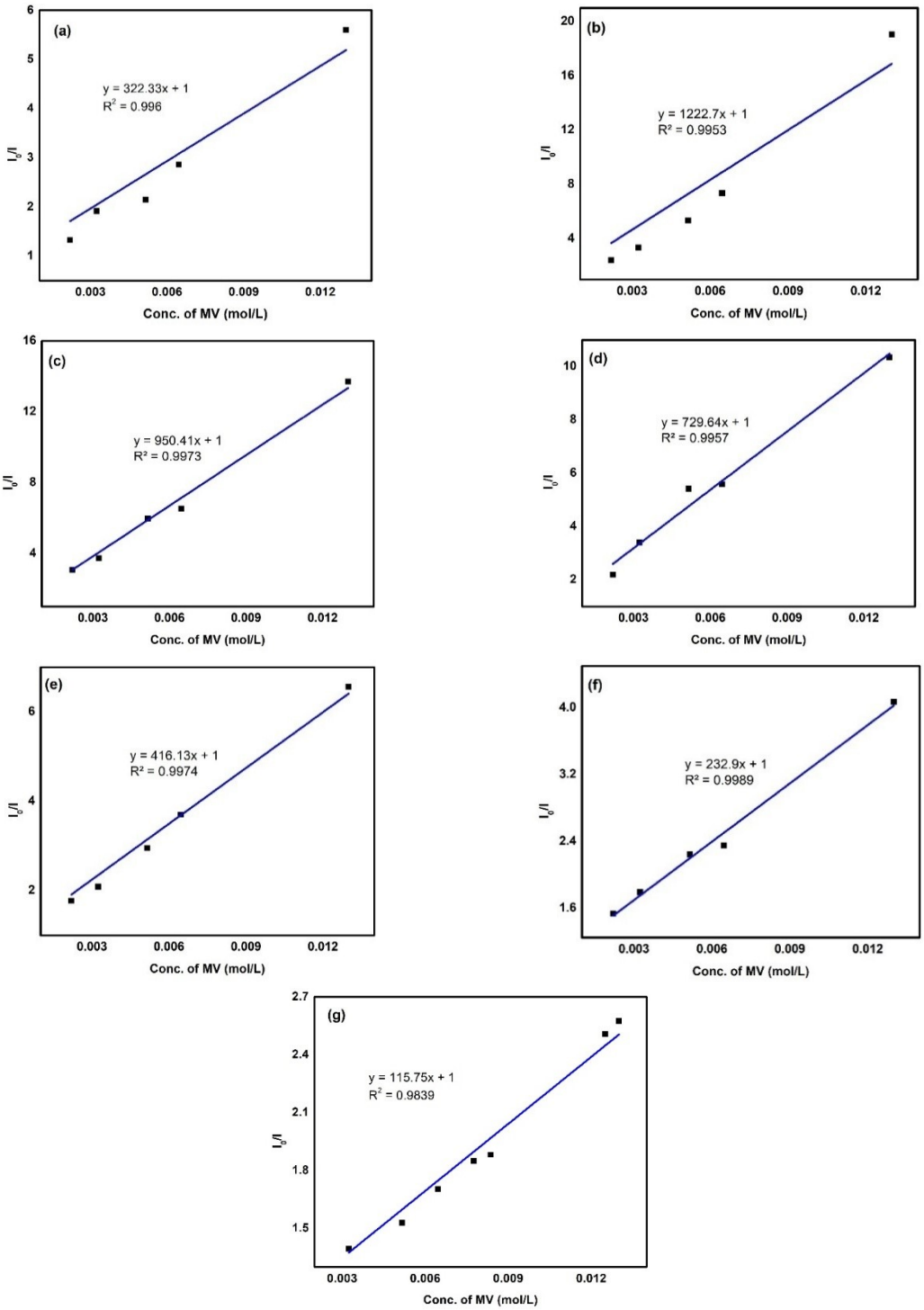

Fig. S28. Stern-Volmer plots of methyl viologen dichloride hydrate (MV) in Ru $(Bpy)_3^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES.

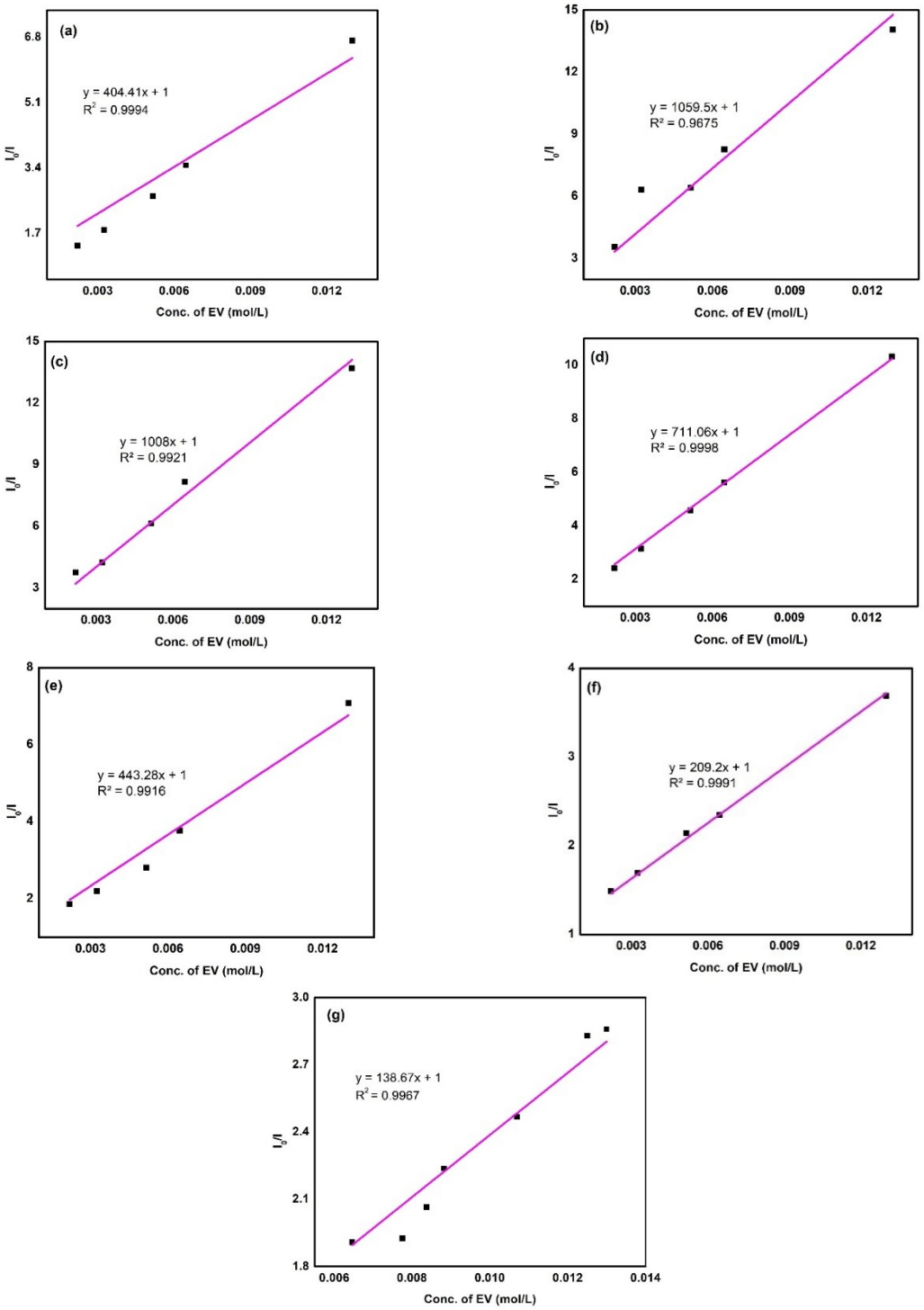

Fig. S29. Stern-Volmer plots of ethyl viologen dibromide (EV) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES.

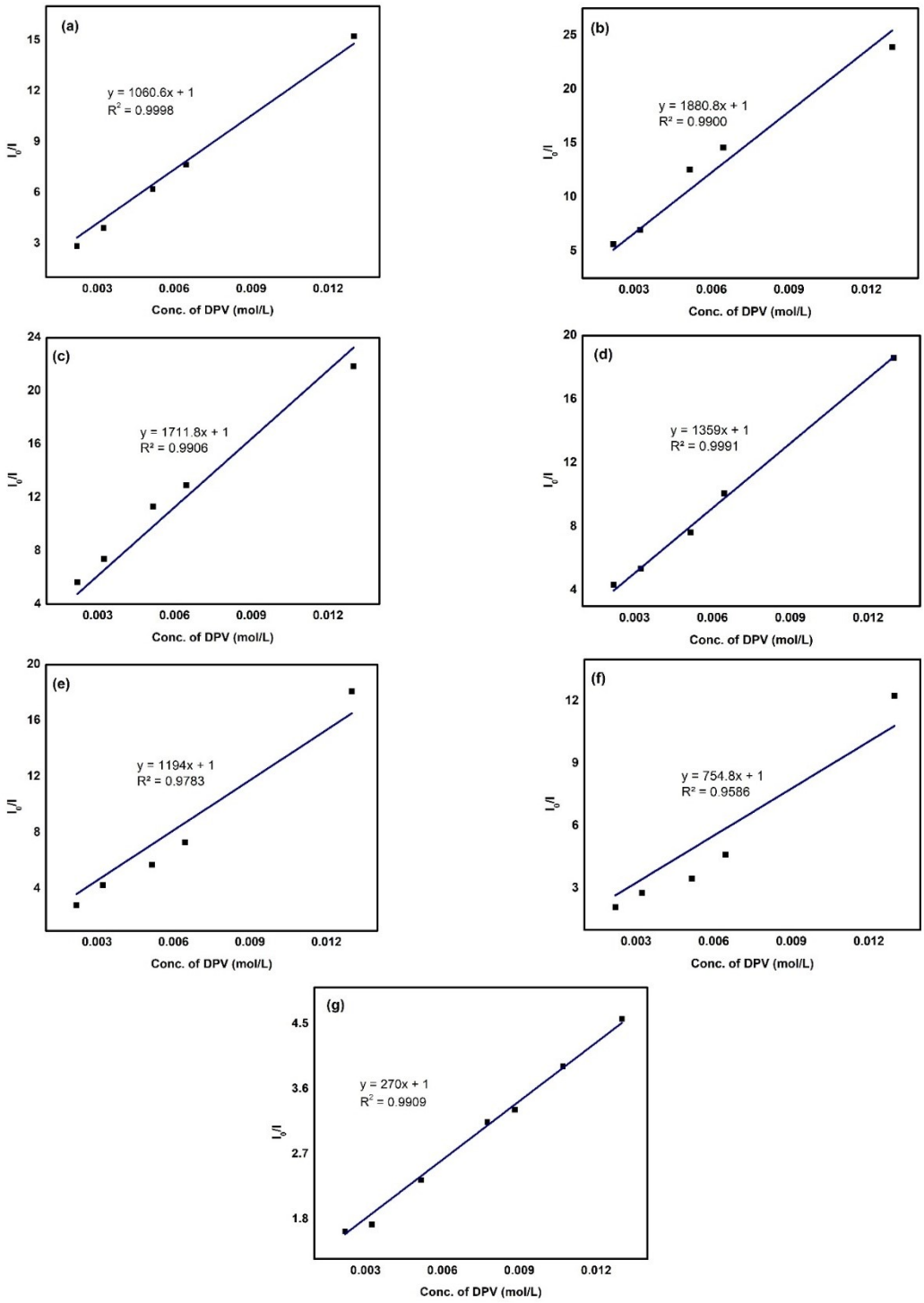

Fig. S30. Stern-Volmer plots of 1,1'-Diphenyl-[4,4'-bipyridine]-1,1'-diium chloride (DPV) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES.

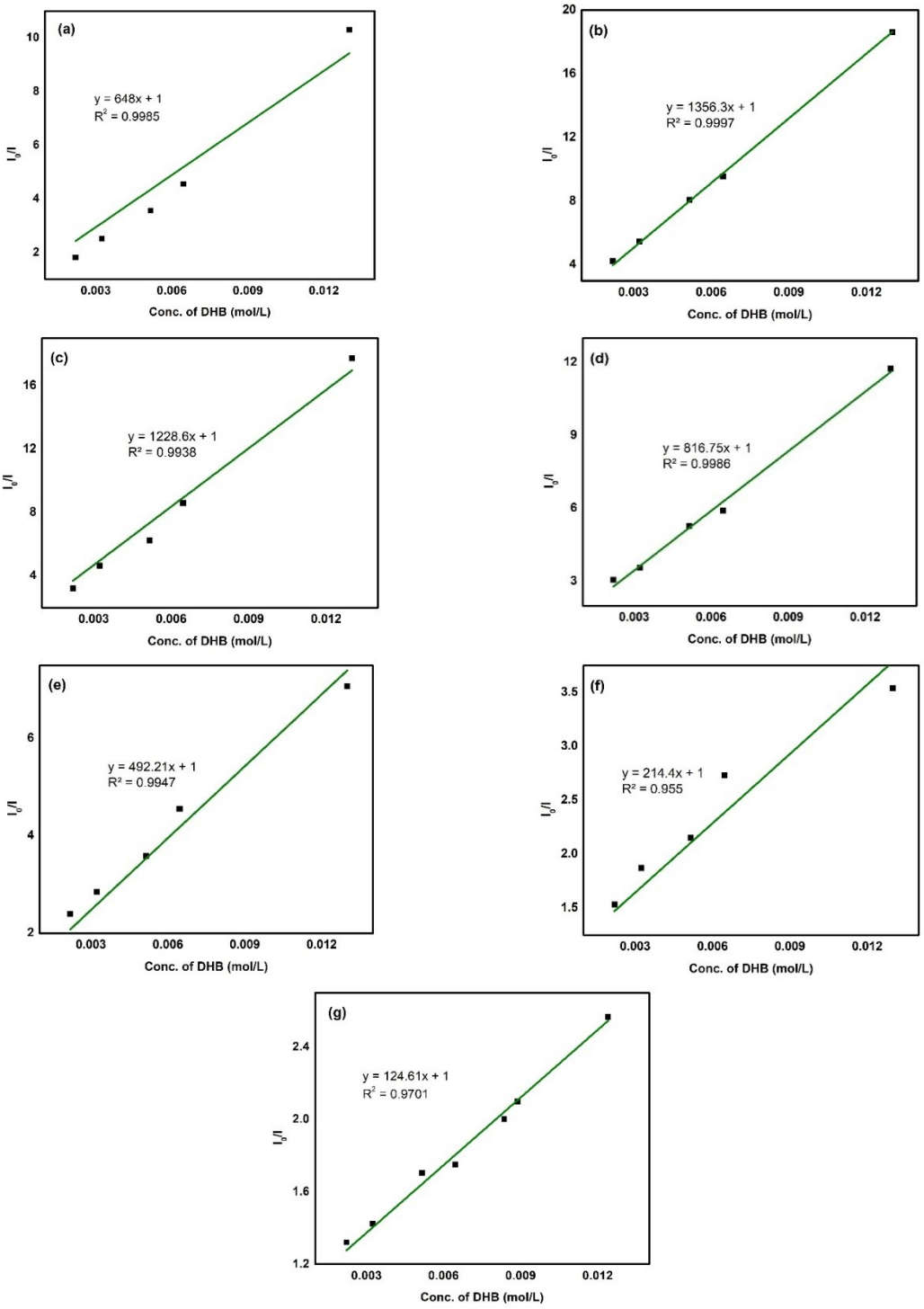

Fig. S31. Stern-Volmer plots of 1,1'-Diheptyl-4,4'-bipyridinium Dibromide (DHB) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES.

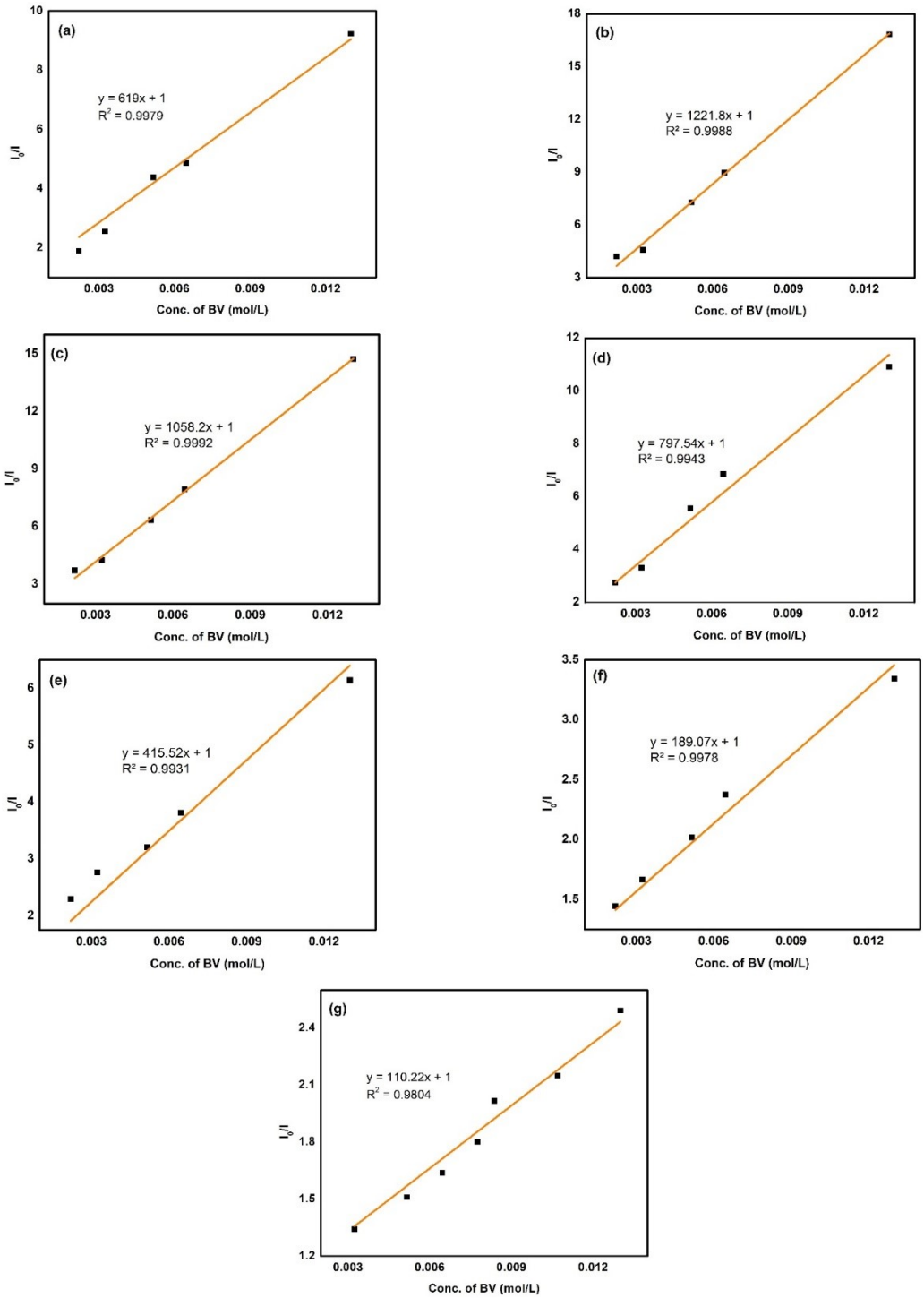

Fig. S32. Stern-Volmer plots of benzyl viologen dichloride (BV) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES.

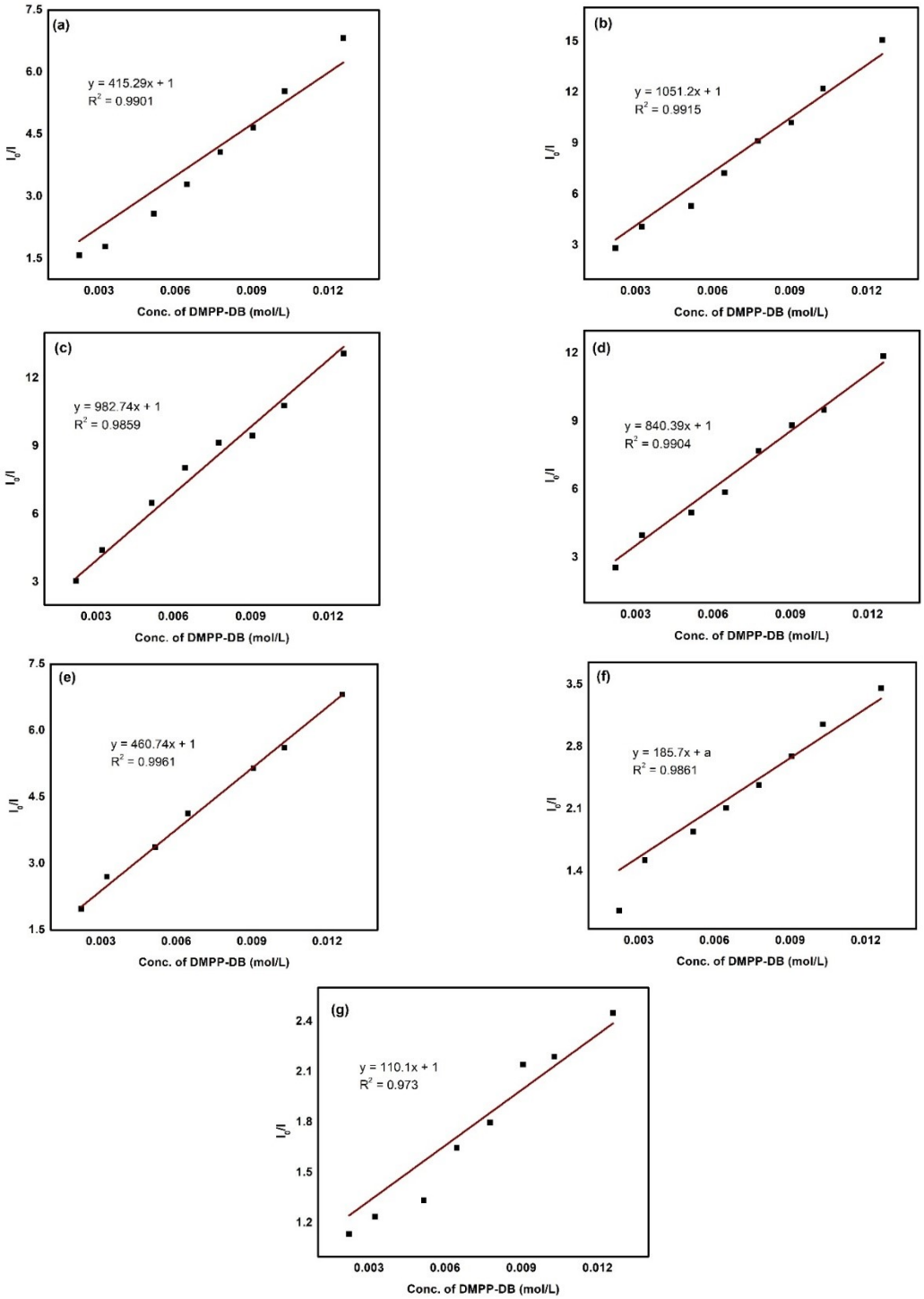

Fig. S33. Stern-Volmer plots of 2,11-Dimethyl-6,7-dihydrodipyrido[1,2-a:2',1'-c]pyrazinediium dibromide (DMPP-DB) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES.

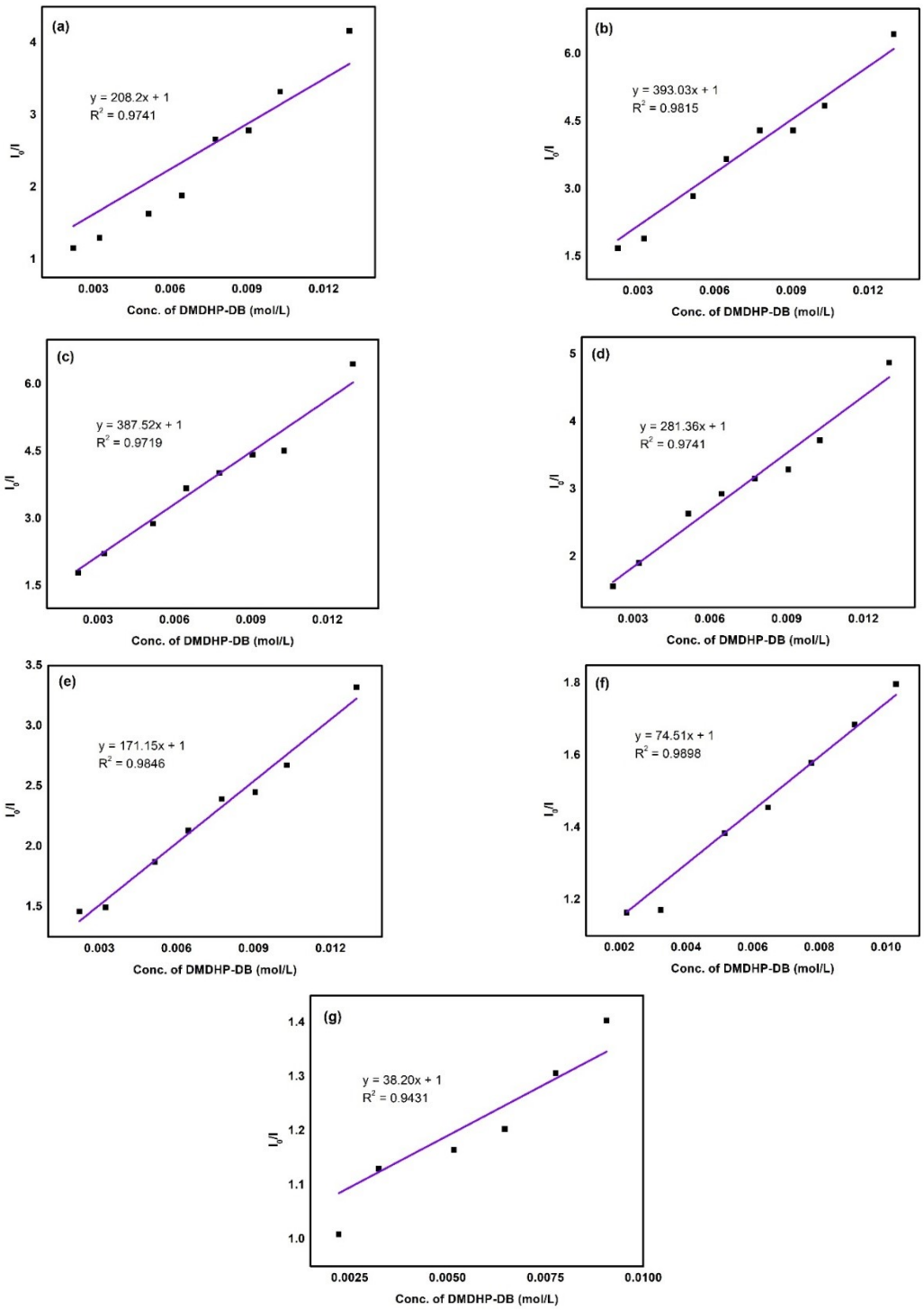

Fig. S34. Stern-Volmer plots of 2,12- Dimethyl-7,8-dihydro-6Ff-dipyrido[l,2-a :2',l'-c]-[l,4]diazepinium Dibromide (DMDHP-DB) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES.

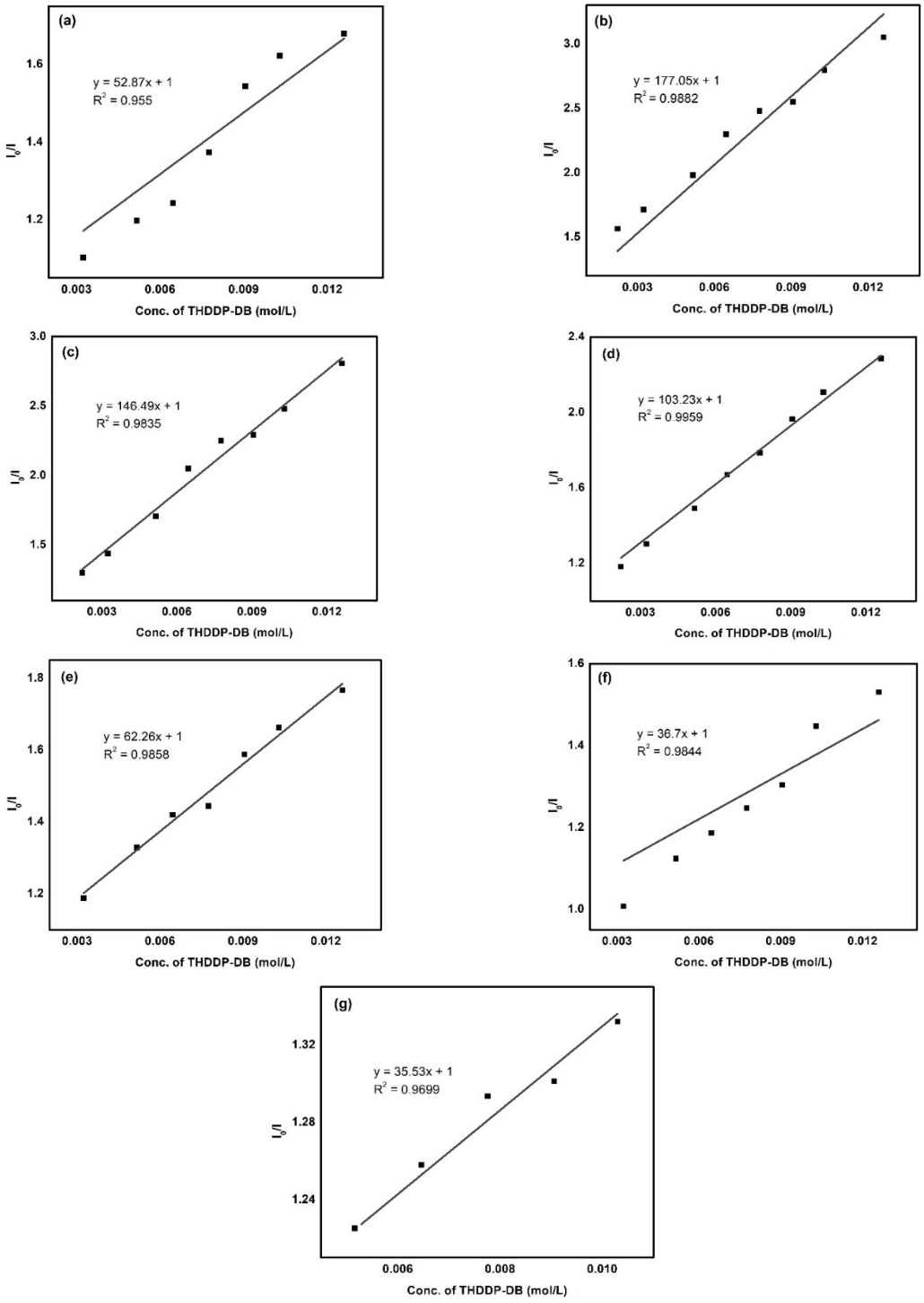

Fig. S35. Stern-Volmer plots of 6,7,8,9-tetrahydro-2,13-dimethyldipyrido<1,2-a:2',1'-c><1,4>diazocinediium dibromide (THDDP-DB) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES.

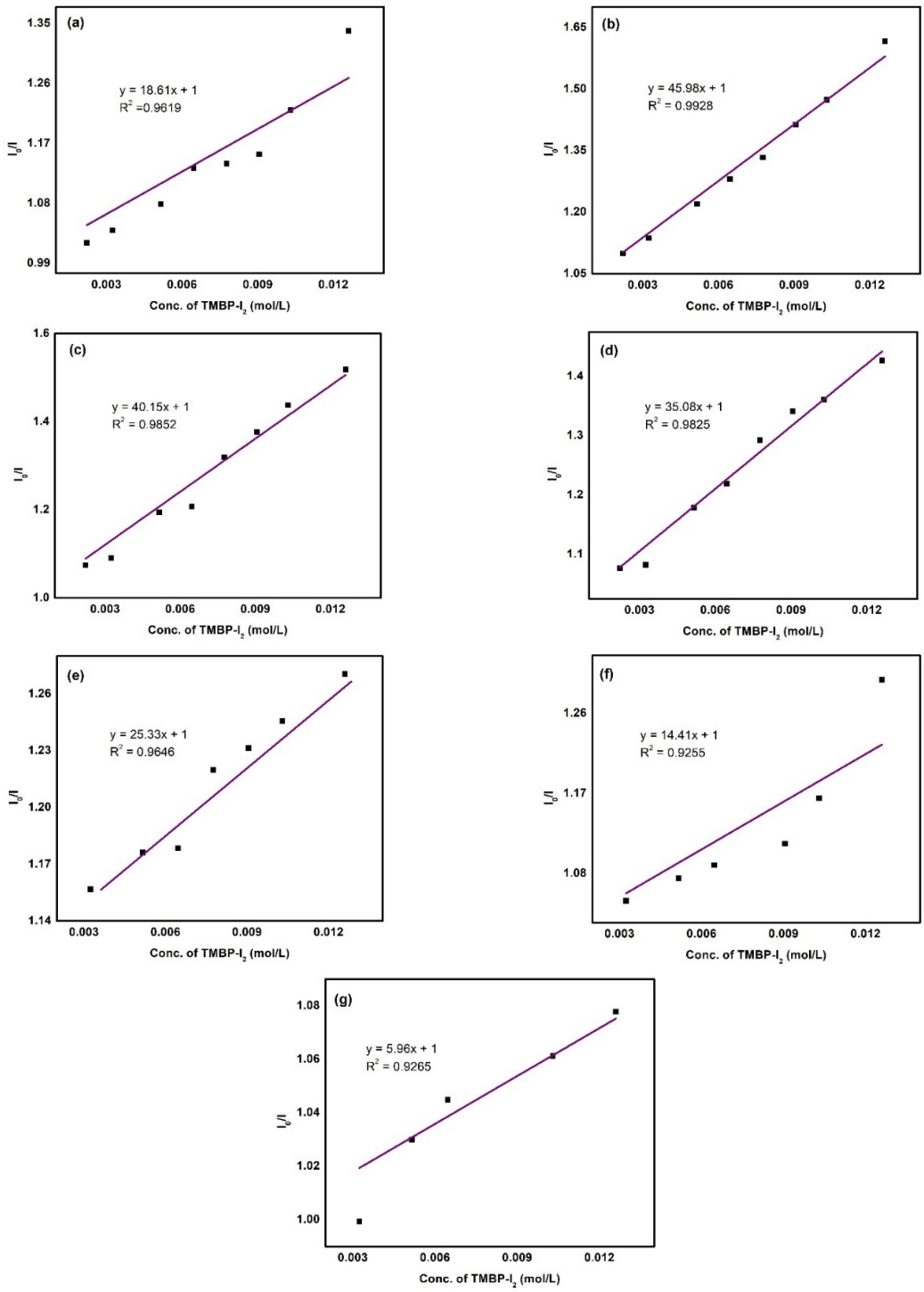

Fig. S36. Stern-Volmer plots of 1,1′,4,4′-Tetramethyl-2,2′-bipyridinium diiodide (TMBP-I_2) in $[Ru(bpy)_3]^{2+}$ in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES.

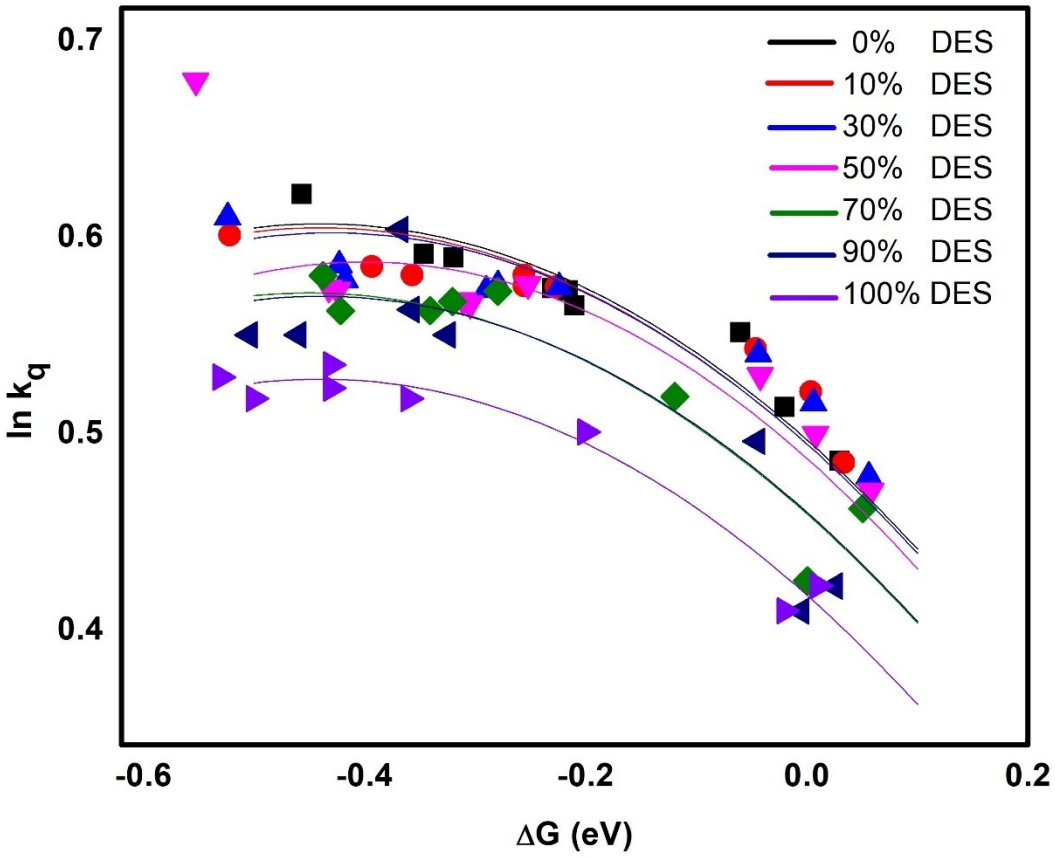

Figure S37: Electron transfer data plotted using Marcus analysis.

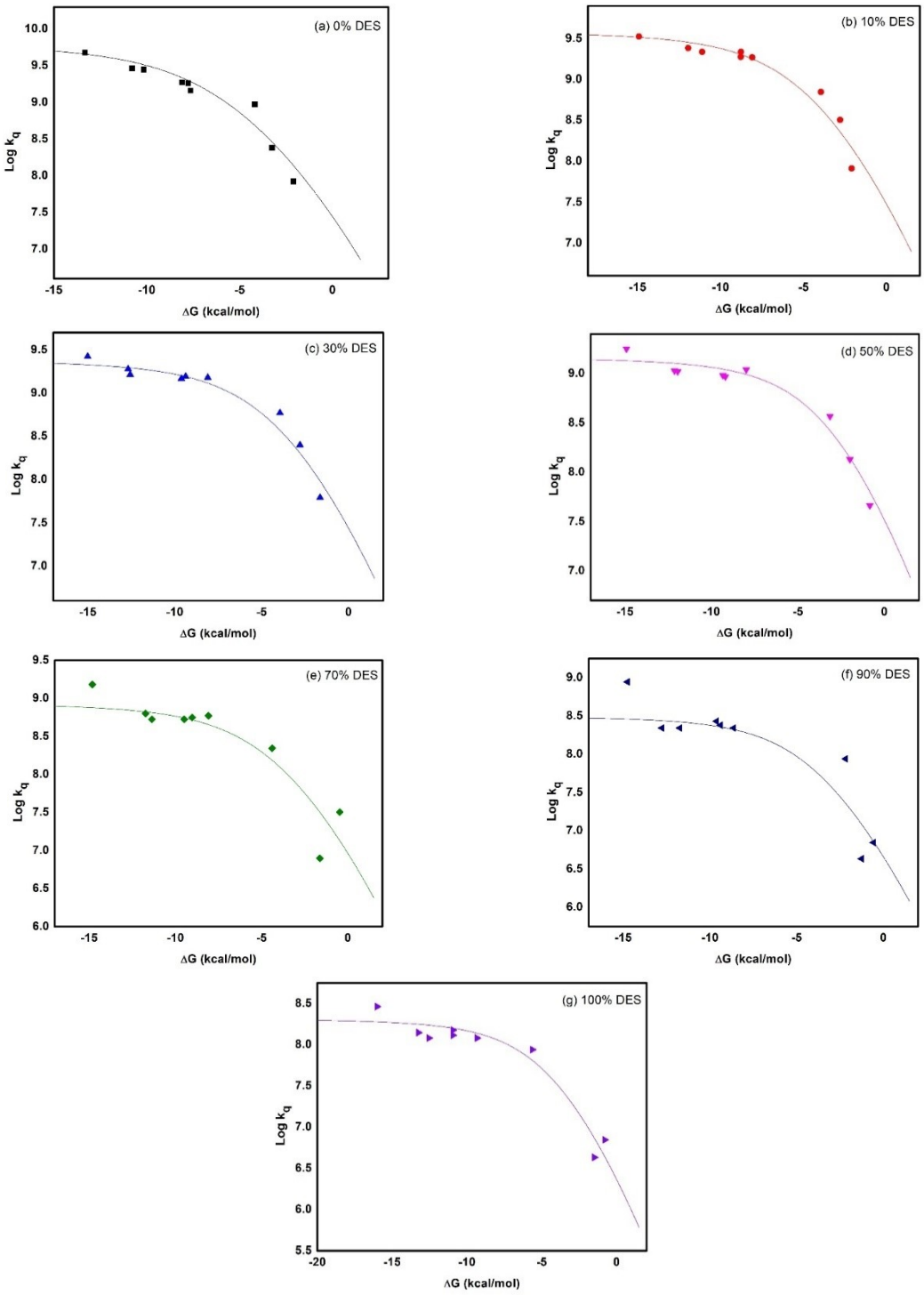

Fig. S38. Rehm-Weller plots of electron transfer data in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES.

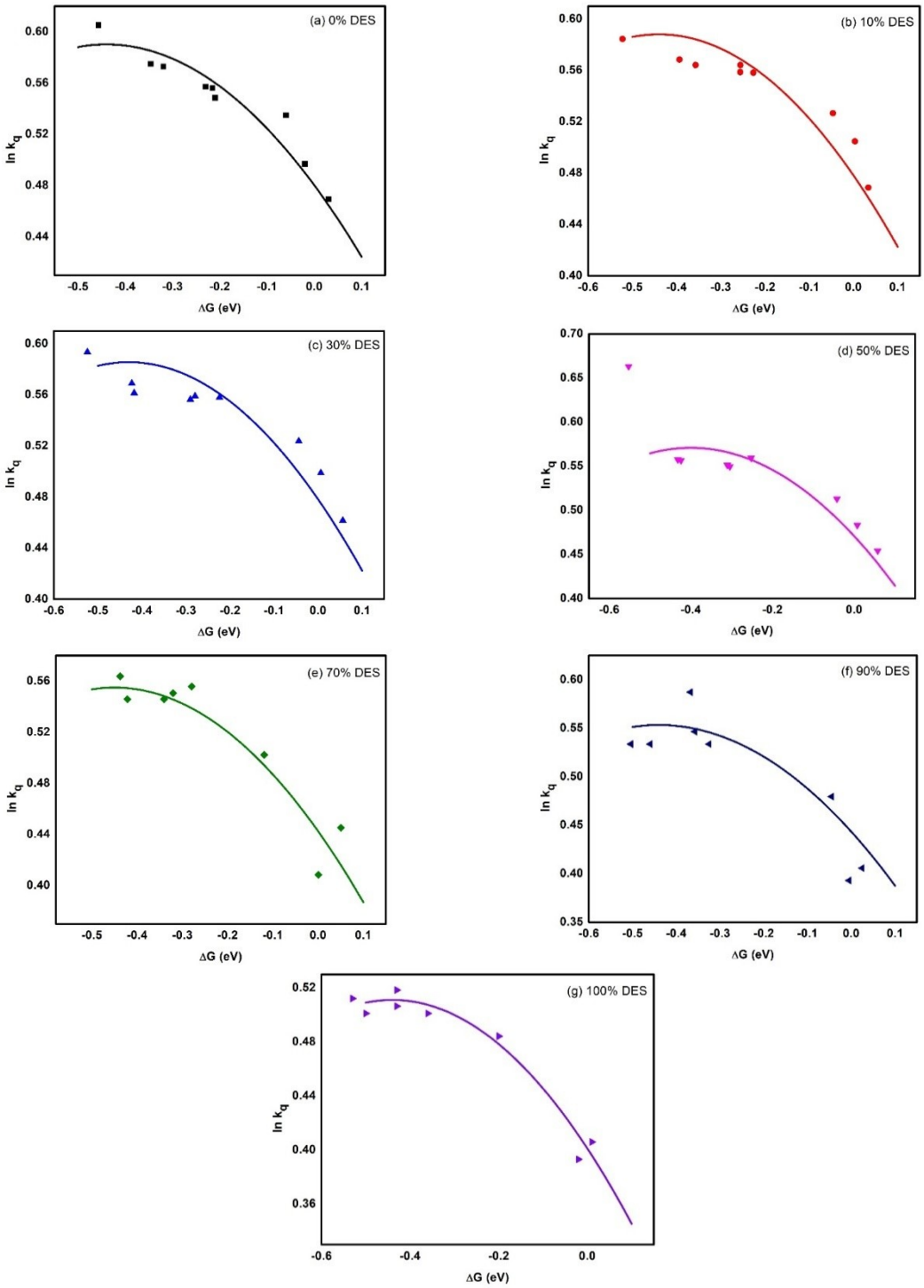

Fig. S39. Marcus theory plots of electron transfer data in (a) 0% DES mixture, (b) 10% DES mixture, (c) 30% DES mixture, (d) 50% DES mixture, (e) 70% DES mixture, (f) 90% DES mixture and (g) 100% DES.

References

(1) Marcus, R. A. Electron Transfer Reactions in Chemistry. Theory and Experiment. *Pure Appl. Chem.* **1997**, *69* (1), 13–29. https://doi.org/10.1351/pac199769010013.