Table 12 Cu^{2+} Selective Electrodes

ionophore	membrane composition	$\lg K_{Cu^{2+},B^{n+}}$	method	primary ion conc. (M)	interfering ion conc. (M)	slope (mV/ decade)	linear range (M)	remarks	ref.
Cu^{2+}-1	**Cu^{2+}-1** (w = 1–4 %), KTpClPB (x_i = 70 %), DDP (w = 66–69 %), PVC (w = 30 %)	Na^+, +1.7; Co^{2+}, +0.0; Ni^{2+}, +0.4; Zn^{2+}, –2.2; Cd^{2+}, +0.6; Pb^{2+}, +0.8	FIM	–	10^{-2}	–	–	20 °C; 4.0 < pH < 5.0; r.o.o.g.	[1]
Cu^{2+}-2	**Cu^{2+}-2** (w = 1–4 %), KTpClPB (x_i = 70 %), DDP (w = 66–69 %), PVC (w = 30 %)	Na^+, –1.3; Co^{2+}, –1.4; Ni^{2+}, –1.0; Zn^{2+}, –1.5; Cd^{2+}, –1.5; Pb^{2+}, –1.0	FIM	–	10^{-2}	39.6	10^{-5} -5×10^{-3}	20 °C; 4.0 < pH < 5.0; r.o.o.g.	[1]
Cu^{2+}-3	**Cu^{2+}-3** (w = 1–4 %), KTpClPB (x_i = 70 %), DDP (w = 66–69 %), PVC (w = 30 %)	Co^{2+}, –2.7; Ni^{2+}, –2.1; Zn^{2+}, –3.4; Cd^{2+}, –2.8; Pb^{2+}, –2.9	FIM	–	10^{-2}	–	–	20 °C; 4.0 < pH < 5.0; r.o.o.g.	[1]
Cu^{2+}-4	**Cu^{2+}-4** (w = 1–4 %), KTpClPB (x_i = 70 %), DDP (w = 66–69 %), PVC (w = 30 %)	Co^{2+},–2.0; Ni^{2+}, –2.3; Zn^{2+}, –1.2; Cd^{2+}, –1.2; Pb^{2+}, +2.1	FIM	–	10^{-2}	29.0	10^{-5} -10^{-2}	20 °C; 4.0 < pH < 5.0; r.o.o.g.	[1]
Cu^{2+}-5	**Cu^{2+}-5** (w = 1–4 %), KTpClPB (x_i = 70 %), DDP (w = 66–69 %), PVC (w = 30 %)	Co^{2+}, –1.3; Ni^{2+}, –1.7; Zn^{2+}, –1.3; Cd^{2+}, +0.3; Pb^{2+}, +2.3	FIM	–	10^{-2}	30.0	10^{-6} -10^{-1}	20 °C; 4.0 < pH < 5.0; r.o.o.g.	[1]
Cu^{2+}-6	**Cu^{2+}-6** (w = 1–4 %), KTpClPB (x_i = 70 %), DDP (w = 66–69 %), PVC (w = 30 %)	Ni^{2+}, –1.1; Co^{2+}, –1.6; Zn^{2+}, –1.7; Cd^{2+}, –1.7; Pb^{2+}, –1.0	FIM	–	10^{-2}	–	10^{-4} -5×10^{-2}	20 °C; 4.0 < pH < 5.0; r.o.o.g.	[1]
	Cu^{2+}-6 (w = 1–4 %), KTpClPB (x_i = 70 %), DDP (w = 66–69 %), PVC (w = 30 %)	Ni^{2+}, –0.2; Co^{2+}, –2.2; Zn^{2+}, –1.0; Cd^{2+}, –0.9; Pb^{2+}, +0.2	FIM	–	10^{-2}	17.5	10^{-5} -10^{-2}	internal solution, 10^{-2} M $Cu(NO_3)_2$; pH = 4	[2]
Cu^{2+}-7	**Cu^{2+}-7** (w = 1–4 %), KTpClPB (x_i = 70 %), DDP (w = 66–69 %), PVC (w = 30 %)	Co^{2+}, –1.4; Ni^{2+}, –1.4; Zn^{2+}, –1.0; Cd^{2+}, –0.4; Pb^{2+}, +1.9	FIM	–	10^{-2}	34.2	10^{-4} -5×10^{-2}	20 °C; 4.0 < pH < 5.0; r.o.o.g.	[1]
Cu^{2+}-8	**Cu^{2+}-8** (w = 1–4 %), KTpClPB (x_i = 70 %), DDP (w = 66–69 %), PVC (w = 30 %)	Co^{2+}, –1.5; Ni^{2+}, –1.5; Zn^{2+}, –1.0; Cd^{2+}, –0.5; Pb^{2+}, +2.0	FIM	–	10^{-2}	33.6	10^{-4} -5×10^{-2}	20 °C; 4.0 < pH < 5.0; r.o.o.g.	[1]

continues on next page

Table 12 Cu^{2+} Selective Electrodes (*Continued*)

ionophore	membrane composition	$\lg K_{Cu^{2+},B^{n+}}$	method	primary ion conc. (M)	interfering ion conc. (M)	slope (mV/ decade)	linear range (M)	remarks	ref.
Cu^{2+}-9	**Cu^{2+}-9** (w = 1–4 %), KTpClPB (x_i = 70 %), DDP (w = 66–69 %), PVC (w = 30 %)	Co^{2+}, –1.0; Ni^{2+}, –1.4; Zn^{2+}, –2.2; Cd^{2+}, –1.5; Pb^{2+}, +0.1	FIM	–	10^{-2}	22.3	10^{-5} –10^{-1}	internal solution, [2] 10^{-2} M $Cu(NO_3)_2$; pH = 4; r.o.o.g	
Cu^{2+}-10	**Cu^{2+}-10** (w = 1 %), KTpClPB (x_i = 70 %), DDP (w = 67.7 %), PVC (w = 30 %)	Co^{2+}, –1.5; Ni^{2+}, –1.5; Zn^{2+}, –1.3; Cd^{2+}, –1.0; Pb^{2+}, –0.2	FIM	–	10^{-2}	25.1	10^{-6} –10^{-1}	internal solution, [2] 10^{-2} M $Cu(NO_3)_2$; pH = 4; r.o.o.g.	
	Cu^{2+}-10 (w = 2 %), KTpClPB (x_i = 70 %), DDP (w = 65.3 %), PVC (w = 30 %)	Co^{2+}, –2.0; Ni^{2+}, –2.0; Zn^{2+}, –1.8; Cd^{2+}, –1.0; Pb^{2+}, –0.2	FIM	–	10^{-2}	–	–	internal solution, [2] 10^{-2} M $Cu(NO_3)_2$; pH = 4; r.o.o.g.	
	Cu^{2+}-10 (w = 3 %), KTpClPB (x_i = 70 %), DDP (w = 63 %), PVC (w = 30 %)	Co^{2+}, –0.7; Ni^{2+},–2.0; Zn^{2+}, –3.1; Cd^{2+}, –2.0; Pb^{2+}, –1.2	FIM	–	10^{-2}	29.6	10^{-5} –10^{-2}	internal solution, [2] 10^{-2} M $Cu(NO_3)_2$; pH = 4; r.o.o.g.	
	Cu^{2+}-10 (w = 4 %), KTpClPB (x_i = 70 %), DDP (w = 60.6%), PVC (w = 30 %)	Co^{2+}, –3.1; Ni^{2+}, –3.0; Zn^{2+}, –2.9; Cd^{2+}, –1.8; Pb^{2+}, –0.8	FIM	–	10^{-2}	–	–	internal solution, [2] 10^{-2} M $Cu(NO_3)_2$; pH = 4; r.o.o.g.	
Cu^{2+}-11	**Cu^{2+}-11** (w = 1–4 %), KTpClPB (x_i = 70 %), DDP (w = 66–69 %), PVC (w = 30 %)	Co^{2+}, –4.8; Ni^{2+}, –4.8; Zn^{2+}, –5.3; Cd^{2+}, –4.7; Pb^{2+}, +3.5	FIM	–	10^{-2}	33.2	10^{-6} –10^{-2}	internal solution, [2] 10^{-2} M $Cu(NO_3)_2$; pH = 4; r.o.o.g.	
Cu^{2+}-12	**Cu^{2+}-12** (w = 4.1 %), oNPOE (w = 54.8 %), PVC (w = 41.1 %)	Na^+, –3.7; K^+, –3.7; Ca^{2+}, –1.9; Mg^{2+}, –4.0; Sr^{2+}, –4.0; Mn^{2+}, –3.7; Ni^{2+}, –3.8; Co^{2+}, –3.8; Zn^{2+}, –3.9; Cd^{2+}, –4.4; Pb^{2+}, –1.8	MSM	–	–	30	–	25.0 ± 0.1 °C; [3] t_{resp} = 27 s; 3.2 < pH < 5.4; $c_{dl} = 2.0 \times 10^{-8}$ M; r.o.o.g.	
Cu^{2+}-13	**Cu^{2+}-13** (w = 5.4 %), oNPOE (w = 54.1 %), PVC (w = 40.5 %)	Na^+, –3.8; K^+, –3.8; Mg^{2+}, –2.3; Ca^{2+}, –2.6; Sr^{2+}, –2.8; Mn^{2+}, –3.1; Ni^{2+}, –2.6; Co^{2+}, –3.6; Zn^{2+}, –1.5; Cd^{2+}, –2.6; Pb^{2+}, –3.4	MSM	–	–	31	–	25.0 ± 0.1 °C; [3] $c_{dl} = 1.0 \times 10^{-8}$ M; t_{resp} = 10 s; 3.0 < pH < 6.5; r.o.o.g.	
Cu^{2+}-14	**Cu^{2+}-14** (w = 5.4 %), oNPOE (w = 54.1 %),	Na^+, –1.5; K^+, –0.8; Mg^{2+}, –2.6; Ca^{2+}, –3.2;	MSM	–	–	31	–	25.0 ± 0.1 °C; [3] $c_{dl} = 4.0 \times 10^{-7}$ M;	

Table 12 Cu^{2+} Selective Electrodes (*Continued*)

ionophore	membrane composition	$\lg K_{Cu^{2+},B^{n+}}$	method	primary ion conc. (M)	interfering ion conc. (M)	slope (mV/ decade)	linear range (M)	remarks	ref.
	PVC (w = 40.5 %)	Sr^{2+}, –2.7; Mn^{2+}, –2.5; Ni^{2+}, –2.3; Co^{2+}, –2.8; Zn^{2+}, –1.0; Cd^{2+}, –4.3; Pb^{2+}, –0.9						t_{resp} = 6 s; 3.7 < pH < 6.3; r.o.o.g.	
Cu^{2+}-15	**Cu^{2+}-15** (w = 6.9 %), oNPOE (w = 34.3 %), KTpClPB (x_i = 24 %), PVC (w = 57.2 %)	Na^+, –2.7; K^+, –2.3; Mg^{2+}, –3.6; Ca^{2+}, –3.6; Sr^{2+}, –3.7; Mn^{2+}, –2.5; Ni^{2+}, –3.2; Co^{2+}, –4.0; Zn^{2+}, –2.2; Cd^{2+}, –4.4; Pb^{2+}, –0.7	FIM	–	10^{-1} (Na^+, K^+) 10^{-2} (other cations)	29	–	25.0 ± 0.1 °C; $c_{dl} = 4.0 \times 10^{-7}$ M; t_{resp} = 9 s; 3.2 < pH < 5.5; r.o.o.g.	[4]
Cu^{2+}-16	**Cu^{2+}-16** (w = 5.8 %), oNPOE (w = 46.6 %), PVC (w = 41.7 %), NaTFPB (x_i = 14 %)	Na^+, –2.5; K^+, –2.0; Mg^{2+}, –2.7; Ca^{2+}, –3.0; Sr^{2+}, –2.8; Mn^{2+}, –2.4; Ni^{2+}, –3.2; Co^{2+}, –3.2; Zn^{2+}, –2.3; Cd^{2+}, –2.8; Pb^{2+}, –0.9	FIM	–	10^{-1} (Na^+, K^+) 10^{-2} (other cations)	28	–	25.0 ± 0.1 °C; $c_{dl} = 3.9 \times 10^{-7}$ M; t_{resp} = 31 s; 3.4 < pH < 6.1; r.o.o.g.	[4]
	Cu^{2+}-16 (w = 5.4 %), oNPOE (w = 54.1 %), PVC (w = 40.5 %)	Mg^{2+}, –2.8; Ca^{2+}, –3.3; Mn^{2+}, –2.4; Ni^{2+}, –3.0; Co^{2+}, –1.9; Cd^{2+}, –2.1	FIM	–	10^{-2}	29	–	25.0 ± 0.1 °C; $c_{dl} = 4.0 \times 10^{-7}$ M; t_{resp} = 20 s; 3.4 < pH < 6.1; r.o.o.g.	[4]
Cu^{2+}-17	**Cu^{2+}-17** (w = 7 %), DOP (w = 31 %), PVC (w = 62 %)	Ni^{2+}, –1.0; Co^{2+}, –1.0	–	–	–	28	–	t_{resp} < 10 s; $c_{dl} = 10^{-6}$ M;	[5]
Cu^{2+}-18	**Cu^{2+}-18** (w = 2.6 %), DOP (w = 64 %), KTpClPB (x_i = 128 %), PVC (w = 32 %)	K^+, interferes; Ca^{2+}, –1.7; Cd^{2+}, –2.0; Pb^{2+}, –1.6	FIM	–	0.1 0.01	31	–		[6]
Cu^{2+}-19	**Cu^{2+}-19** (w = 9.2 %), DOP (w = 60 %), KTpClPB (x_i = 19 %), PVC (w = 30 %)	K+, interferes Ca^{2+}, –1.9; Cd^{2+}, –2.1; Pb^{2+}, –1.7	FIM	–	0.1 0.01	54–59	–		[6]

(1) Z. Brzózka, *Analyst*, **113**, 891-893 (1988).
(2) Z. Brzózka, *Analyst*, **113**, 1803-1805 (1988).
(3) S. Kamata, A. Bhale, Y. Fukunaga, H. Murata, *Anal. Chem*., **60**, 2464-2467 (1988).
(4) S. Kamata, Y. Kubo, H. Murata, A. Bhale, *Analyst*, **114,** 1029-1031 (1989).

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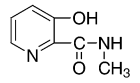
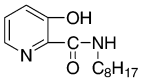
Table 12 Cu^{2+} Selective Electrodes (*Continued*)

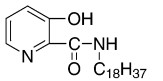
(5) J. Casabó, L. Escriche, S. Algret, C. Jaime, C. Pérez-Jiménez, L. Mestres, J. Rius, E. Molins, C. Miravitlles, F. Teixidor, *Inorg. Chem.*, **30**, 1893-1898 (1991).
(6) P.L.H.M. Cobben, R.J.M. Egberink, J.G. Bomer, P. Bergved, W. Verboom, D.N. Reinhoudt, *J. Am. Chem. Soc.*, **114**, 10573-10582 (1992).



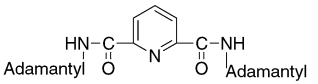
Cu^{2+}-1 (M_r = 152.15)



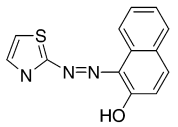
Cu^{2+}-2 (M_r = 250.34)



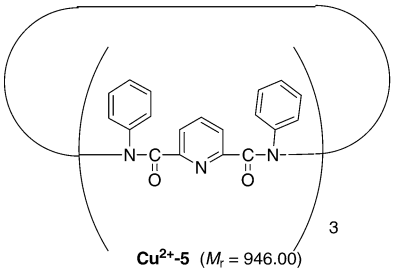
Cu^{2+}-3 (M_r = 390.61)



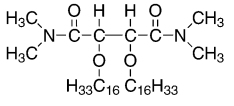
Cu^{2+}-4 (M_r = 439.65)



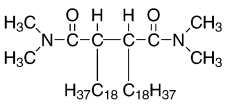
Cu^{2+} -6 (M_r = 255.30)



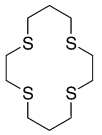
Cu^{2+}-5 (M_r = 946.00)



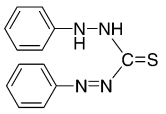
Cu^{2+}-7 (M_r = 653.09)



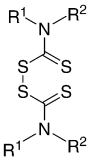
Cu^{2+}-8 (M_r = 677.20)

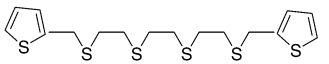


Cu^{2+} -9 (M_r = 268.51)



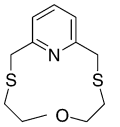
Cu^{2+} -10 (M_r = 256.33)



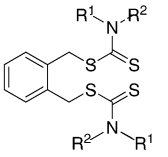


Cu^{2+} -11 (M_r = 406.71)

Cu^{2+} -12 (M_r = 296.52): R^1=R^2=C_2H_5
Cu^{2+} -13 (M_r = 408.74): R^1=R^2=C_4H_9
Cu^{2+} -14 (M_r = 717.34): R^1=CH_3, R^2=$C_{18}H_{37}$

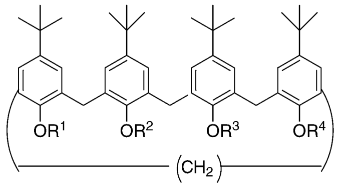


Cu^{2+}-17
(M_r = 241.36)



Cu^{2+} -15 (M_r = 512.89): R^1=R^2=*i*-C_4H_9
Cu^{2+} -16 (M_r = 821.49): R^1=CH_3,
R^2= $C_{18}H_{37}$

Table 12 Cu^{2+} Selective Electrodes (*Continued*)



Cu^{2+} -18 (M_r = 1294.06):
$R^1=R^2=R^3=R^4=CH_2CH_2SCH_2C(S)N(CH_3)_2$

Cu^{2+} -19 (M_r = 1055.66): $R^1=R^3=$ propyl,
$R^2=R^4=CH_2CH_2SCH_2C(S)N(CH_3)_2$