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Solvation Interaction Parameters Between $CuCl_2$ and Orange G (OG) at 19.1°C Using Carbon Glassy Electrode (CGE) in KCl Aqueous Solutions

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Abstract

The redox mechanisms were examined for copper chloride in absence and presence of Orange G (OG) at 19.1°C cyclic voltammetry using carbon glassy electrode (CGE). The supporting electrolyte used is 0.1 M KCl effect of scan rate was also studies for the redox reactions for $CuCl_2$ alone and in presence of the ligand used orange G (OG). Stability constants for the complex formed from the interaction of $CuCl_2$ with Orange G (OG) were evaluated with the different thermochemical data. Effect of different scan rates were examined for cupric chloride in absence and presence of the ligand used Orange G (OG).

Keywords: Solvation parameters, Cyclic voltammetry, Copper chloride, Orange G (OG), Glassy carbon electrode (CGE)

Introduction

Extraction of metal ions as pollutants from aqueous solutions by use of electrochemical methods is very interesting for environmental aim [1-6]. Several metal ions in solutions can be recorded and examined by the reduction of the different cathode materials [6, 7]. In this work estimation and electrochemical voltammetric analysis of copper ions in 0.1 M KCl was studied to explain the characteristics for evaluating it in the environmental samples. Long exposure to copper cause many problems, irritation in eyes, nose, mouth, causes headaches, dizziness, vomiting and diarrhea. High uptake copper many cause kidney and liver damage [7]. Copper is vital dietary, small amount of metal is needed for well-being [8]. Copper [9] is most third abundant metal in the body [8-10]. In this work estimation and electrochemical voltammetric analysis of copper ions in 0.1M KCl was studied for explaining the characteristics for evaluating it in the environmental sample

Experimental

The chemical used $CuCl_2$, KCl used are of high purity from Sigma Aldrich Co .Orange G (OG) is of the type Ranken (Ranbaxy). The volume of the experimental solution is 30 ml. Three electrode cell was used connected to potential DY 2100,Ag /AgCl, KCl $_{sat.}$, reference electrode, carbon glassy electrode (CGE) was used as working electrode, platinum wire was also used as auxiliary electrode.N_2 flow was done to ensure oxygen removal . The carbon glassy electrode (CGE) is prepared in our laboratory from pure carbon piece, polished with aluminum oxide on wool piece. Area of electrodes 0.502 cm^2.

Results and discussion

Electrochemical behavior of $CuCl_2$ in absence of Orange G (OG)

Studying electrochemical behavior for $CuCl_2$ in 0.1M KCl supporting at19.1°C was done in the range from +1V to -1V. In range -1 to +1V oxidation took place, but scanning in the range of +1 and-1 permits and allows the copper reduction processes and ligand reduction if found .The change of Cu (II) to the Cu (III) state (d^8low / spin) involves the reduction of metal ion radius [11]. Cyclic voltammogram between 1 and -1 V (Volt) show redox processes explaining C(II)/Cu(I) and Cu(I)/Cu(0) processes appearing in Fig.1.

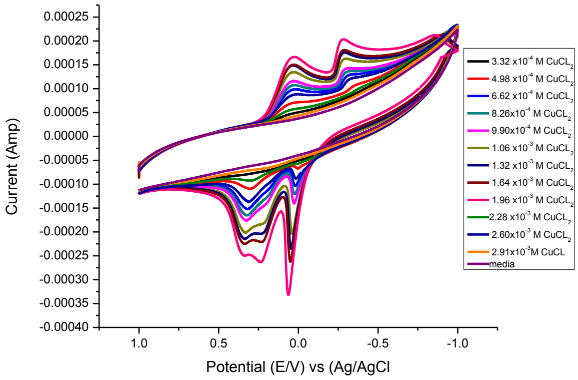

Fig. 1: Cyclic voltammograms of different concentration of $CuCl_2$ in 0.1MKBr solutions at 19.1°C

Scan rate was also studied for $6.62x10^{-4}$ M of $CuCl_2$, at 0.01, 0.02, 0.05 and 0.1 V/S, and 100,50,20 and 10 mV/second. All redox waves were appeared to increase on increasing scan rate as shown in Fig. 2.

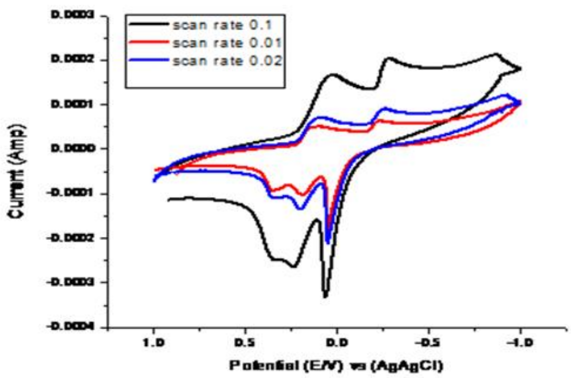

Fig. 2: Effect of scan rates on the cyclic voltammograms of $CuCl_2$ in 0.1M KBr at 19.1°C.

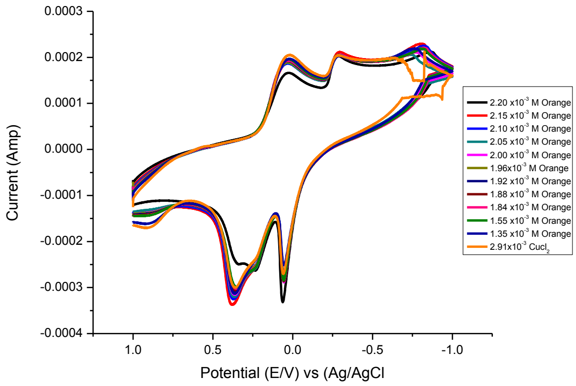

Fig. 3: Voltammograms of the interaction of different concentrations of Orange (G) with 1 mM $CuCl_2$ in 0.1M KBr supporting electrode

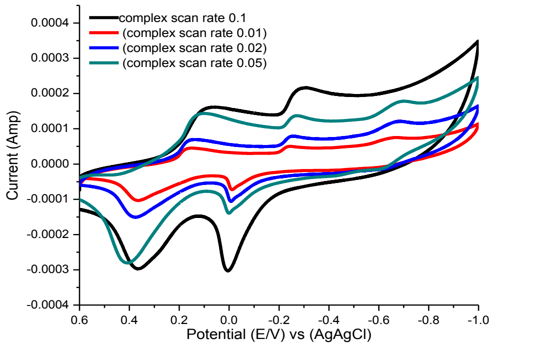

Fig. 4: Voltammograms at different scan rates of 1:1 (Metal/OG) stoichiometric complexes

Cyclic voltammetry of $CuCl_2$ in presence of ligand Orange G

Electrochemical behaviour of complex formed from the interaction of $CuCl_2$ with Orange G was oxadied cyclic voltammetrically in the range of 1 to-1V

The potential reduction of Cu(||)/Cu(|) processes is studied. The electro chemical activity in range studied showed pattern at all $Cucl_2$ concentrations that may considered as sum of individual processes.

[Cu (|||) OG]+e- ⇄ [Cu(||)OG]……….(1)

Reaction of $CuCl_2$ with gradual addition of ligand Orange G (OG) were recorded until1:3 (ML/Ligand) molar ratio was reached. Change in color and in electrochemical behavior was clear from the first addition. The changes increase when the ligand additions increase. Wave Cu (|||)/Cu(||) complexes appear at higher concentrations of orange G (OG). Anaysis of the voltammograms were done as explained inliteratures [10-19] and the obtained data are given in Table (1) for the interaction of $CuCl_2$ with Orange (G).

Table 1:

Table 1: Effect of concentration for ligand Orange G (OG)) at 0.1 scan rate at 19.1^{0}C.

L x 10^{-3}	DcX 10^{-10}	Epc/2	αnac	Ks C x 10^{-3}	Γ cx 10^{-8}	(+) Qc x 10^{-4}	Γ a x 10^{-8}	(-) Q a x 10^{-4}	Log βj	βj	(-)ΔG (KJ/mol)
0.244	5.29E	0.1309	0.6545	1.55	4.5328	1.37	3.3356	1.01	2.9893	975.8303	16.7277
o.477	5.67	0.1373	0.6246	1.59	4.5828	1.39	5.4090	1.64	3.3176	2077.8341	18.5645
0.699	6,15	0.1401	0.6243	1.46	4.6619	1.41	5.3825	1.63	3.5088	3227.7327	19.6349
0,911	6.58	0.1373	0.6368	1.54	4.7122	1.43	3.8279	1.16	3.7335	5414.6523	20.8921
1.11	6.77	0.1369	0.6252	1.57	4.6717	1.42	5.0318	1.52	3.9533	8981.2892	22.1219
1.31	7.17	0.1365	0.6719	1.53	4.7020	1.42	5.1774	1.57	4.1941	15638.198	23.4696
1.49	7.85	0.1342	0.5821	1.55	4.8172	1.46	4.5587	1.38	4.2305	17003.458	23.6730
1.67	7.83	0.1373	0.6580	1.54	4.7108	1.43	4.5264	1.37	4.6167	41380.428	25.8344
1.84	9.08	0.1327	0.5656	1.78E	4.9678	1.51	4.8385	1.47	4.6924	49255.821	26.2578
3.11	12.9	0.1293	0.5706	2.19	4.9953	1.51	4.8132	1.46	6.6758	4740697.8	37.3563
4.04	19.1	0.1261	0.5526	2.83	5.2626	1.59	4.6934	1.42	8.6203	417161413	48.2370

Conclusion

Thermochemical parameters for complex interaction between $CuCl_2$ with Orange G (OG) prove the stability of the complex formed. All data given in text prove the reversible diffusion process of the system under consideration

References

M. Hunsin, K. Prmksakorn, S. Damonglerd, H. Vegnesk, P. Duverneuit, Water Res., 39(2005)610-61.

N. M. S. Kaminaria ,D.R.Shult2, M. J. Ponte, H. A. Ponte, C. E. B. Marina,

C. Neta, Chem. Eng.J., 126(2007) 139-146.

C. B. Basha, N. S. Bhadrinarayana, N. Anantharaman, K. M. M. S. Begam, J. Hazard Mater., 152(2008)71-78.

L. Doulabes, K. Nory, S. Stuchi, Ch. Comninellis, Electrochim. Acta, 46 (2000)349-356.

C. C. Yang, J. Power Sources, 115(2003)352-359.

N. P. Brandon, D. Pilone, G. H. Kelson, Q. Yin, J. Appl. Electrochem., 23(2003)853-862.

J. Osredkar, N. Sustar, J. Clinical Toxilog., 45 (2011) 2-18.

A.M. Pizarro, F. Olivares, M. Arredonda, M. Gonzalez, Biol.Res. (2006)183-187.

E. France, E. L′opez-Torres, M. M. Mendiola, M. T. Sevilla, Polyhedron, 19(2000) 441-451.

D. X. West, E.LIberta, S. B. Padhye, R. C. Chikate, P. B. Sonawane, A.S. Kumbar, R.S.Yeranda, J. Hazard Mater. 123(1993)49-55.

S. E. EL-Shereafy, E .A. Gomaa, A. H. Yousif and A. S. Abou El-Yazed, Iran. J. Mat. Sci. Eng. ,14(4)(2000)11-20.

E. K. Telhan , R. G .Compton, Chem. Electochem., 2(2015) 64-67.

S. Eloul , R. G. Compton, J. Phys. Chem. C, 114 (2015) 27540-27549.

R. S. Nicholson, Anal. Chem., 37(11) (1965) 1351-1355.

A. M. El-Askalany, M. Abou–EL-Magd, Chem. Pharm. Bull., 42(10)(1995) 1791-1792.

K. M. Ibrahim, E. A. Gomaa, R. R. Zaky, M. Abdel Hady, Amer. J. Chem.. 2(2012)23-26.

E. A. Gomaa, Inter. J. Mater. Chem., 2 (1)(2012)16-18.

E. A. Gomaa, Phys. Chem. Liq.s, 50(2012)279-283.

E. A. Gomaa, Amer. J. Polym. Sci., 2(3), (2012)35-47.

عنوان البحث: معلمات تفاعل الذوبان بين CuCl2 و Orange G (OF) عند ١٩,١ درجة مئوية باستخدام القطب الكهربي الزجاجي (CGE) في محاليل KCl المائية

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يتضمن البحث دراسة السلوك الفولتا ميتري لكلوريد النحاس باستخدام قطب الكربون الزجاجي في وجود محلول بروميد البوتاسيوم كمحلول الكتروليتى. كما تم دراسة السلوك الكهروكيميائي لأكسدة واختزال النحاس في كلوريد النحاس في غياب وفي وجود Orange G (OG) كمادة مخلبية. كذلك تم دراسة تأثير التركيزات المختلفة من كلوريد النحاس & Orange G على موجات الأكسدة والاختزال المتكونة.