RJC
http://www.rasayanjournal.com

RASĀYAN *J. Chem.*
Vol.3, No.3 (2010), 581-583
ISSN: 0974-1496
CODEN: RJCABP

ELECTRODE KINETICS OF Ga(III) COMPLEXES WITH L-TYROSINE AT DIFFERENT TEMPERATURE BY POLAROGRAPHIC TECHNIQUE

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ABSTRACT
Polarographic behaviour of Ga(III) has been investigated with the L-Tyrosine at dropping mercury electrode and the reduction of Ga(III) has been found to be irreversible in the supporting electrolyte with or without complexing agent. In the present study of complexes of Ga(III) are investigated and their kinetic parameters have been evaluated. Transfer coefficient (α) and formal rate constant (K^o_{fh}) have been determined with the ligand L-Tyrosine in aqueous medium at 300K and 308K by applying Koutecky's method.
Keywords: Gallium(III), L-Tyrosine, dropping mercury electrode, kinetic parameters, Koutecky's method.

INTRODUCTION

Equation for the polarographic current potential curve corresponding to a totally irreversible process whose rate governed by a single electron transfer step has been obtained by several authors[1,2].
A plot of E_{de} Vs log $i/(i_d\text{-}i)$ employing average current in the logrithimic term should be linear and should have slope of $0.0591/\alpha n$ volts at 25°C. Complexation of Gallium(III) with L-serine, L-methionine has been investigated potentiometrically by Bianco et al.[3]. The researchers have also worked extensively on extraction and synthesis of variety of complexes of Gallium[4,5]. Polarography is one of the popular technique considered for the study of complexes and kinetics of irreversible reactions[6]. An extensive work has been carried out on the electrochemical behaviour of amino acis and their complexes with several metal ions by many workers[7,8]. Vinita Sharma[9-11] carried out the electrode kinetic study of Ga(III) with DL-α-alanine, N-glycyl-glycine and pyridine in aqueous and aqueous ethanol medium. The kinetics of alanine at a DME was studied in solution with the Paladium by V.N. Spiridonov et al.[12]. the kinetics of anticancer drug Zileutron was investigated DCP and DPP using DME by N.Y. Sreedhar et al.[13]. Kinetic parameters and stability constants of complexes of Mn with doxycycline, chlortetra cycline, oxytetra cycline, tetra cycline monocycline, amoxicillin reported polarographically by Farid Khan and Rakhi Agrawal[14]. The literature search reveals that Polarographic study of Gallium(III) complexes with L-Tyrosine has not been attempted so far. This fact inspired us to investigate polarograpic behaviour of Ga(III).

EXPERIMENTAL

Polarograms were obtained with a carefully calibrated polarograph. The test solutions were prepared using conductivity water. The solutions contain 0.1M of Ga(III) and different concentrations of ligand. The solution of KNO_3 of 1M concentration was used as supporting electrolye to maintain the ionic strength constant of the solution and 0.002% Triton-X-100 was used as maximum suppressor. Before examining the solutions polarographically, purified nitrogen gas was passed through each solution for 10-15 min. to remove dissolved oxygen. The bridge compartment of the cell was thoroughly cleaned and refilled with fresh saturated solution of potassium chloride just before each polarogram was recorded.

RESULTS AND DISCUSSION

The value of half-wave potential ($E^r_{1/2}$) exhibits cathodic shifts and diffusion current shows descending behaviour with increase in the concentration of L-Tyrosine. This indicates complexation between Gallium(III) and L-Tyrosine and variation in the size of Ga(III) and L-Tyrosine on the formation of complex. The number of electrons involved in the reduction process of Gallium found to be three. By knowing the value of 'n' the diffusion coefficient ($D^{1/2}$) of the depolarizer was calculated by using Ilkovic equation at different concentration of the ligand.

The effect of increasing concentration of L-Tyrosine on polarographic characteristic and kinetic parameters are recorded in Table 1 at 300K and 308K, respectively. The and decrease in the values of 'α' with increase in concentration of the ligand, implies that the transfer of electrons is getting increasingly difficult and the reduction of Ga(III) can also be noticed from the decreasing trends of K^0_{fh}.

The effect of temperature on different parameters can also be measured. The results show that $E^r_{1/2}$ values shifts to more positive values as the temperature increased which indicates the easier reduction of Ga(III)-L-Tyrosinate system at d.m.e. The values of 'α' and K^0_{fh} show an increase with the temperature shows that the electrode reduction of Ga(III)-L-Tyrosinate system tends to become less irreversible as the temperature is increased.

The results show, that there is a regularity in the variation of the values of standard rate constant K^o_{fh}. As the concentration of the ligand increases, the values of formal rate constant decreases on increasing the temperature the value of formal rate constant K^o_{fh} decreases.

The reason of decreases of formal rate constant at higher temperature may be due to the breaking of chelating rings. At higher temperature the rings may be broken down and the complexes. The stoichiometric factor may also affect the complexing row of the metal. At higher temperature the bidentate chelated ligand may become more energetic to collide which might be causing faster reaction.

CONCLUSION

We conclude that the values of diffusion co-efficient ($D^{1/2}$) and transfer coefficient (α) are higher at 308K than 300K, and the values of formal rate constant (K^o_{fh}) are lower at higher temperature.

ACKNOWLEDGEMENT

The authors are thankful to the Head, Department of Chemistry, University of Rajasthan, Jaipur for providing facilities to carry out this research. One of the authors (Santosh Kumar) is thankful to UGC for the awarding Rajeev Gandhi Research Fellowship.

Table-1: Kinetic parameters of Ga(III) in various concentration of L-Tyrosine at 300K and 308K

	at 300K				at 308K			
C_x mM	$D^{1/2}$ $cm^2\ sec^{-1}$	α	$E^r_{1/2}$ $-V$ vs Sec^{-1}	$\log K^0_{fh}$ $cm\ sec^{-1}$	$D^{1/2}$ $cm^2\ sec^{-1}$	α	$E^r_{1/2}$ $-V$ vs Sec^{-1}	$\log K^0_{fh}$ $cm\ sec^{-1}$
0	-	0.2840	1.2285	-	-	0.3093	1.2061	-
0.001	13.3979	0.2836	1.2296	-3.9879	13.7287	0.3070	1.2073	-4.2535
0.002	6.6989	0.2825	1.2308	-4.2773	6.7816	0.3043	1.2085	-4.5209
0.003	4.3556	0.2809	1.2319	-4.4425	4.4108	0.3019	1.2098	-4.6756
0.004	3.2254	0.2798	1.2331	-4.5592	3.2667	0.2992	1.2112	-4.7694
0.005	2.5141	0.2780	1.2344	-4.6446	2.5472	0.2969	1.2125	-4.8463
0.006	2.0400	0.2763	1.2359	-4.7138	2.0951	0.2947	1.2137	-4.9000
0.007	1.7249	0.2747	1.2371	-4.7640	1.7485	0.2932	1.2151	-4.9619

C_x = L-Tyrosine

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(Received: 17 June 2010 Accepted: 31 July 2010 RJC-583)