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Evaluation of Some Thermodynamic Parameters by Conductometric Studies on Er(III)-Complexes with Indole Derivatives in Non-Micellar and Micellar Systems

[1]Ramswaroop Regar*, [2]Sumit Ghasia, [3]Hemendra Singh Bhandari
[1,2,3]Assistant Professor
[1,2]P.G. Department of Chemistry, SK Government Girls College, Sikar (India).
[3]GCRC, P.G. Department of Chemistry, Govt. Dungar College, Bikaner, Rajasthan (India)
MGS University, Bikaner (Rajasthan)

Abstract: Conductometric titration curves of Erbium(III)-complexes with Nitrogen and Oxygen containing ligand Indole derivative [viz : 1*H*-indole -3-carboxylic acid (I3CA), 1-(1*H*-indole-3-yl) ethanone (3ATI), 1*H*-indole-3-carbaldehyde (I3CD), 2-(1*H*-indole-3-yl)ethanoic acid (2IEA), 4-(1*H*-indole-3-yl)butanoic acid (4IBA)] have been studied and analyzed in non-micellar solvent (Alcohol+water) and micellar surfactant medium [Polyethylene glycol monododecyl ether (BRIJ35), Cetyltrimethylammonium bromide (CTAB), Sodium dodecyl sulphate (SDS)] at 298 K temperature. The Association constant K_A , Gibbs free energy of association ΔG_A , formation constant or stability constant K_f as $\log K_f$ and Gibbs free energy of formation ΔG_f have been calculated with the help of conductometric titration curves of Erbium(III)-with Indole derivative (I3CA, 3ATI, I3CD, 2IEA, 4IBA) at 298 K temperature in non-micellar medium and different micellar surfactant medium. Metal-ligand complexes in 1:1, 1:2, 1:3 [M:L] ratio is obtained as inflammation point in the plot of molar conductance Λ_m (S cm^2 mol^{-1}) and ligand/metal $[L]_t$ / $[M]_t$ ratio. Stability of 1:1, 1:2, 1:3 [M:L] metal ligand complexes have been evaluated in term of formation constant as $\log K_f$ and thermodynamic parameter $\Delta G_{f.}$ Stability of Erbium(III)-complexes shows somewhat different behavior on increasing the ligand/metal $[L]_t$ /$[M]_t$ ratio and alteration of different micellar medium.

Index Terms - Conductometric titration, non-micellar and micellar medium, molar conductance, surfactant, thermodynamic parameter, stability constant.

1. INTRODUCTION

The physiochemical properties of metal ion and organic ligand complexes are affected by various solvent systems, whether these solvents are micellar or non-micellar. Changes in physiochemical properties of complexes, in the presence of different solvent systems reflects in nature of bonding [Paz, F.A.A. et al, 2012, Wang, K.X. and Chen, J.S. 2011, Gayathri, K. et al, 2022, Wen, L. et al, 2007, Sato, O. 2016]. In recent decades, considerable interest in lanthanide metal-ligand interaction have been reported. The Optical absorption and Conductometric studies are concern with the metal-ligand interaction in different solvent systems [Uphoff, M. et al, 2018, Irfanullah, M. and Iftikhar, K. 2010]. Lanthanide and their coordination behavior with organic compounds play an important role in emerging fields of luminescence, medical diagnosis (MRI), treatment and palliation of cancer, industries, petroleum, glass, ceramics and analytical fields. Now a days use of lanthanide for proper functioning of biological system are well established. Lanthanide compounds have their use in luminescent chemosensors, shift reagents, medical diagnosis of disease and optical cell imaging [Bünzli, J.C.G. and Piguet, C. 2005, Caravan, P. 2009, Siddiqui, M.R. et al, 2017]. Conductometric titration, potentiometry, polarography, colorimetry, spectrophotometry, voltammetry and fluorescence spectroscopy techniques are used to evaluate the various parameters and metal ligand interaction since so far. [Majeed, S. et al, 2022, Farris, S. et al, 2012, Amin, A.S et al, 2015, Okafor, C et al, 2014, Dzyadevych, S. and Jaffrezic-Renault, N. 2014, Li, J. et al, 2004]. On the review of all these techniques, the conductometric titration method are found highly sensitive, easy handling, eco-friendly, low-cost requirement and uncomplicated instrumental experimental technique [Abdusalyamova, M.N. et al, 2014, Jatolia SN and Bhandari HS. 2014, Bradshaw, J.S. et al, 1980, Khan, A.M. et al, 2018]. On the review of literature, it is found that lanthanide metal- complexes with organic ligands have greater extent of interaction with the different solvent systems [Kakhki, R.M. 2019, Khalili, R. and Moridi, A. 2023, Feng, X. et al, 2010]. The interaction of metal and ligand are detected through the strengthening in stability of metal-ligand complexes [Song, L. et al, 2021]. Stability of metal-ligand complexes can be altered through the replacement of non-micellar (alcohol+water) solvent by non-ionic, cationic and anionic micellar solvents. Micellar Surfactants which are used to evaluate the thermodynamic parameters, are found sensitive with the environment. Micellar solvents have low toxic impacts on the environment and its sustainability [Płotka-Wasylka, J. et al, 2017, El-Sagher, H.M. and Farghaly, O.A. 2017].

This conductometric study are focused on the interaction and analysis of thermodynamic parameter of lanthanide metal and organic N, O-donor ligand related to complexes of Er(III) with Indole derivative. Aim of this conductometric study to know metal-ligand interaction, stoichiometry ratio of metal-ligand complexes, spontaneously formation of complexes and their stability. For this Er(III) metal ion solution conductometrically titrated with different Indole derivatives I3CA, 3ATI, I3CD 2IEA and 4IBA in non-micellar Alcohol+water medium and micellar medium CTAB, SDS, BRIJ35, BRIJ35, CTAB respectively.

2. EXPERIMENTAL SECTION

2.1 Preparation of Solutions

Erbium(III)chloride have been used for experiment, are manufactured by central drug house (P) Ltd. All five ligands 1*H*-indole -3-carboxylic acid (I3CA) , 1-(1*H*-indole-3-yl) ethanone (3ATI), 1*H*-indole-3-carbaldehyde (I3CD), 2-(1*H*-indole-3-yl)ethanoic acid (2IEA), 4-(1*H*-indole-3-yl)butanoic acid (4IBA) are used, manufactured by Qualigens, Thermo fisher scientific, India Pvt Ltd. Standard solution of Erbium(III)chloride and ligands are prepared of 0.05 M concentration. Solvent ethanol of AR grade 99.9% purity, double distilled water, BRIJ35 of 100 CMC (9×10^{-3} M), SDS of 50 CMC (6×10^{-1} M), and CTAB of 45 CMC (9.9×10^{-1} M) manufactured by Loba Chemia Pvt. Ltd. Mumbai India, are used to prepare solutions of metal and ligands. For the measurement of conductivity, highly sensitive DDS-12 DW conductivity meter has been used for different metal and ligands system, at constant temperature 298 K. This DDS-12 DW conductivity meter has a cell constant 1.0 cm^{-1} and temperature accuracy $\pm 1^0C$ during the entire experiment. In this experiment, metal solutions having 1×10^{-3} M concentration and ligands I3CA, 3ATI, I3CD, 2IEA, 4IBA having concentration 1×10^{-2} M are prepared in non-micellar ethanol+water and micellar medium solutions BRIJ35 nonionic surfactant, SDS anionic surfactants, CTAB cationic surfactants.

2.2 Procedure for conductometric method

For conductometric study the Er(III) metal ion solution (25 mL of 1×10^{-3} M) put in the thermostat and conductivity is measured by conductivity meter. Ligand solutions I3CA, 3ATI, I3CD, 2IEA, 4IBA in different mediums added to Er(III) metal solution by 0.4 mL increment in each addition. The specific conductance of different solutions is measured experimentally by conductivity meter which is converted into corrected conductance using (V+v)/V as dilution occurs by adding the ligand solution into the metal solution [Al–Farhan, B.S. et al, 2018, Naggar, A.H. et al, 2018, Gomaa, E.A. et al, 2014]. Corrected conductance converted into the molar conductance Λ_m [Raviprakash, Chandra S. et al, 2017]. By extrapolating of the graph between molar conductance Λ_m (S $cm^2 mol^{-1}$) and $C_m^{1/2}$ $(Mol/L)^{1/2}$ to zero concentration, limiting molar conductance Λ_o was obtained [Volmer, D.A. et al, 2017]. Plot between the molar conductance Λ_m and ligand/metal ratio $[L]_t$ / $[M]_t$ has been drawn for ligands (I3CA, 3ATI, I3CD, 2IEA, 4IBA) in different medium non micellar as well as in micellar medium.

2.3 Calculations of Association Constant K_A and Gibbs Free Energy of Association G_A

Association constant are calculated by [Gomaa, E.A. et al, 2017, Gomma, E.A. 1987, Gomaa, E.A. and Al-Jahdali, B.A. 2012].

$$K_A = \frac{\Lambda_0^2\ (\Lambda o - \Lambda)}{4\ C_m^2\ \gamma_\pm^2 \Lambda^3 S\ (Z)^2} \quad \text{..........................}(2.1)$$

Λ_o = Limiting molar conductance, Λ = observed molar conductance, C_m= concentration of metal, $\gamma_\pm$ = mean ionic activity coefficient, s(z)= fuoss-shedlovsky factor

Gibbs free energy of Association G_A following formula have been used

$$\Delta G_A = -RT\ ln\ K_A \quad \text{..........................}\ (2.2)$$

2.4 Calculations of Formation Constant K_f and Gibbs Free Energy of Formation ΔG_f

Formation of metal -ligand binding between the Erbium(III) ion and Indole derivative can be shown as

$$M^+ + L \rightleftharpoons ML^+$$

The formation constant K_f or stability constant for above equilibrium is given by [Khushbu K. et al, 2018, Elsayed TH and Esam AG. 2015]

$$K_f = \frac{[ML^+]}{[M^+][\ L]}$$

$$K_f = \frac{\Lambda_{M+} - \Lambda}{\Lambda - \Lambda_{ML} \quad [L]} \quad \text{..........................}(2.3)$$

Λ_{M+} = Molar conductivity of metal, Λ_{ML} = Molar conductivity of complexed cation solution, [L] = Concentration of ligand, Λ = observed molar conductance

Gibbs free energy of Formation G_f was calculated by

$$\Delta G_f = -\ RT\ ln\ K_f \quad \text{...........................}(2.4)$$

3. RESULT AND DISCUSSION

3.1 Conductometric Study of Erbium(III)-Indole Derivative Complexes in Non-micellar and Different Micellar Medium

A negative slope is observed in the Plot of Er(III) metal ion with indole derivative I3CA, 3ATI, I3CD, 2IEA, 4IBA between molar conductance Λ_m and $C_m^{1/2}$ at 298 K temperature in non-micellar (Alcohol+Water) medium and in micellar medium CTAB, SDS, BRIJ35, BRIJ35, CTAB respectively. Extrapolation of graph between molar conductance Λ_m and $C_m^{1/2}$ outcome limiting molar conductance Λ_o. Association constant K_A and Gibbs free energy of association ΔG_A are calculated by using the value of Λ_o and different formula as given in equation [2.1-2.2]. Then these are reported for calculating the thermodynamic parameter *viz.* Association constant K_A and Gibbs free energy of Association ΔG_A of Er(III) with indole derivatives I3CA, 3ATI, I3CD, 2IEA, 4IBA in non-micellar medium Alcohol+Water and micellar surfactant medium BRIJ35, CTAB, SDS.

It is observed that the value of thermodynamic parameters, K_A and ΔG_A for complexes Er(III)-I3CA, Er(III)-3ATI, Er(III)-I3CD, Er(III)-2IEA and Er(III)-4IBA are found higher in non-micellar medium Alcohol+Water than compare to the cationic surfactant CTAB, anionic SDS, nonionic BRIJ35, nonionic BRIJ35 and CTAB surfactant medium respectively. It was also observed that as the concentration of ligands increases, the concentration of Er(III) metal ion solution decreases due to interaction of ligand and metal(III) ion. The thermodynamic parameter such as K_A and ΔG_A are decreased on decreasing the Erbium metal ion concentration in Er(III)-I3CA, Er(III)-3ATI, Er(III)-I3CD, Er(III)-2IEA and Er(III)-4IBA complexes system in all studied non-micellar and micellar surfactant medium.

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Hence, it is inferred that the value of ΔG_A is found negative due to interaction between Er(III) metal ion with Indole derivative I3CA, 3ATI, I3CD, 2IEA, 4IBA and spontaneously association of metal-ligand complexes in different micellar medium CTAB, SDS, BRIJ35, BRIJ35 and CTAB respectively takes place. For this reason, the conductance in the solution is decreased as the complex formation between metal and ligand. The mobility of the metal-ligand complexes Er(III)-I3CA, Er(III)-3ATI, Er(III)-I3CD, Er(III)-2IEA and Er(III)-4IBA are diminished as compared to Erbium(III) free metal ion due to the bulky size of these complex as it can't reach to the surface of the conductivity electrodes. Micellar systems have hydrophobic interaction with metal-ligand complexes.

Furthermore, the different lines with sharp inflammation point which are illustrating the formation of 1:1, 1:2, 1:3 [M:L] ratio are obtained by plotting of the molar conductance Λ_m (S cm^2 mol^{-1}) versus ligand to metal $[L]_t/[M]_t$, total concentration ratio at 298 K temperature as shown in figures-1 to 10. The value of thermodynamic parameters formation constant K_f as $\log K_f$ and ΔG_f of Er(III)-I3CA, Er(III)-3ATI, Er(III)-I3CD, Er(III)-2IEA and Er(III)-4IBA are calculated with the help of equation [2.3-2.4] and reported. The metal-ligand interaction, stoichiometry of metal-ligand complexes and spontaneously complex formation are also described with the help of tables 3.3 Table-1 and 3.4 Table-2. The magnitude of thermodynamic parameters $\log K_f$ and ΔG_f of Er(III)-I3CA are found the better result in CTAB micellar medium as compared to non-micellar medium in 1:1, 1:2, 1:3 [M:L] ratio. It is given an idea about the Spontaneous formation of stable Complex Er(III)-I3CA in micellar medium due to observation of negative value of ΔG_f. The magnitude of $\log K_f$ and ΔG_f of Er(III)-3ATI and Er(III)-I3CD are observed higher in Alcohol+Water medium compare to SDS and BRIJ35 micellar medium respectively while the same parameter for Er(III)-2IEA and Er(III)-4IBA are observed higher in BRIJ35 and CTAB micellar medium respectively as compare to non-micellar medium (Alcohol+Water). The negative value of ΔG_f of all the studied complexes were given an idea about the Spontaneous formation of stable Complexes. The higher negative value of ΔG_f was observed in same medium for 1:1 [M:L] ratio as comparing all the five complexes Er(III)-I3CA, Er(III)-3ATI, Er(III)-I3CD, Er(III)-2IEA and Er(III)-4IBA in 1:1, 1:2, 1:3 [M:L] ratio of metal-ligand complexes due to formation of extended stable metal-ligand complexes spontaneously [Christy, F.A. and Shrivastav, P.S. 2011, Rahimi-Nasrabadi, M. et al, 2009]. The magnitude of thermodynamic parameters $\log K_f$ and ΔG_f of with 1:1, 1:2, 1:3 metal-ligand ratio in non-micellar and micellar medium are presented in 3.4 Table-2.

So, it is concluded that the order of $\log K_f$ was decreased in non-micellar medium (Alcohol+Water) as well as in micellar medium as 1:1 > 1:2 > 1:3 [M:L] stoichiometric ratio approached. Complexes of Er(III) ion with indole derivative I3CA, 3ATI, I3CD, 2IEA, 4IBA in 1:1 metal-ligand stoichiometric ratio are observed higher value of $\log K_f$ and ΔG_f in both non-micellar and micellar medium as compare to 1:2 and 1:3 metal-ligand ratio. Er(III)-I3CA, Er(III)-3ATI, Er(III)-I3CD, Er(III)-2IEA and Er(III)-4IBA complexes with 1:1 [M:L] stochiometric ratio are obtained more stable, feasible complexes with micellar medium as compared to 1:2 and 1:3 [M:L] ratio. These complexes showed the properties of spontaneously formation of complexes and more interaction with 1:1 [M:L] stochiometric ratio in micellar medium as compared to 1:2 and 1:3 [M:L] ratio. It was also observed that as the total concentration of ligand $C_{L[Ligand]}$ was increased to obtain the 1:1, 1:2, 1:3 [M:L] ratio in the conductometric solution then the stability constant $\log K_f$ was lowering due to greater size and overcrowding of the ligand. Hence, stability of complexes decreased towards higher [M:L] ratio. It is also inferred that the micellar surfactant solvent systems showed variation in magnitude of $\log K_f$ and ΔG_f in 1:1, 1:2, 1:3 [M:L] ratio with the variation in ligand and solvent system [Gotmare, A.G. et al, 2016, Helmy, E.T. et al, 2016, Singh, J. et al, 2019].

The highest magnitude in 1:1, 1:2, 1:3 [M:L] ratio for average $\log K_f$ and ΔG_f are established for Er(III)-I3CD (Alcohol+Water), Er(III)-2IEA BRIJ35, Er(III)-I3CD BRIJ35 complex system while lowest for Er(III)-2IEA (Alcohol+Water), Er(III)-2IEA (Alcohol+Water), Er(III)-I3CA CTAB respectively among all the studied system of Er(III) metal complexes. Micellar system showed better stability of complexes. The $\log K_f$ range obtained for Er(III)-indole derivatives complexes in between the 4.04558 to 3.42804 which are the better biological active range in between 2 to 5. Hence, these complexes are significant having more stability and ability to dissociated in biological systems. The $\log K_f$ value are helpful for a chemist in development of novel drugs, drug design and new potential biological active compounds.

3.2 Conductometric Study of Erbium(III)-Indole Derivative complexes in Non-micellar and Different Micellar Medium presented in different graphs.

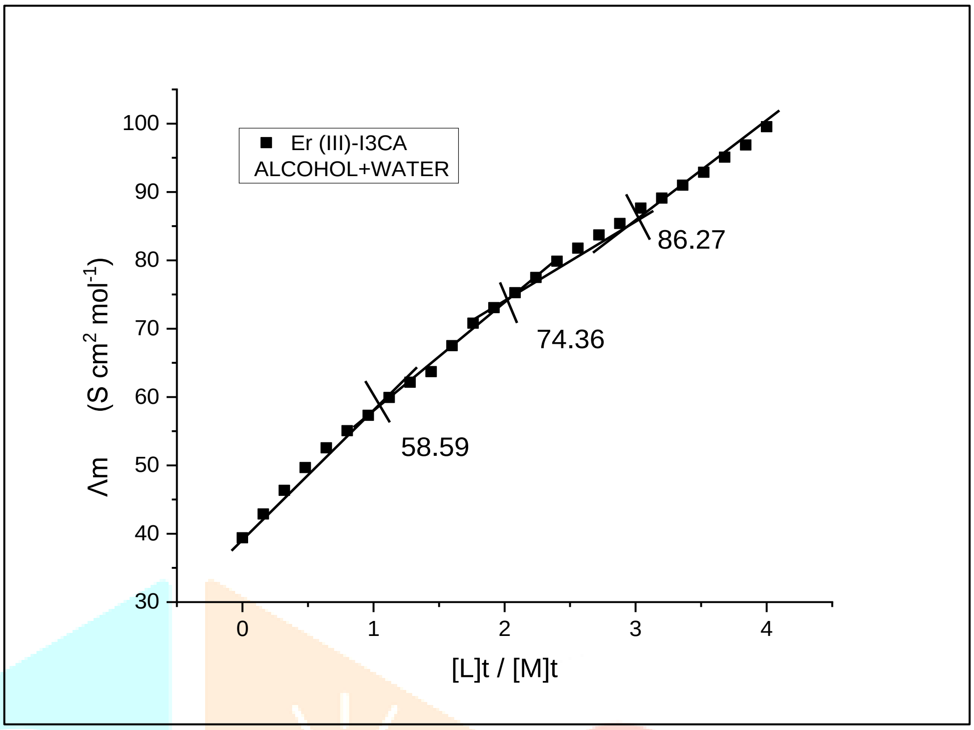

Figure-1 Graph between Molar conductance Λ_m (S cm^2 mol^{-1}) versus I3CA/Erbium(III), $[L]_t$ /$[M]_t$ at temperature 298 K in Alcohol+water medium.

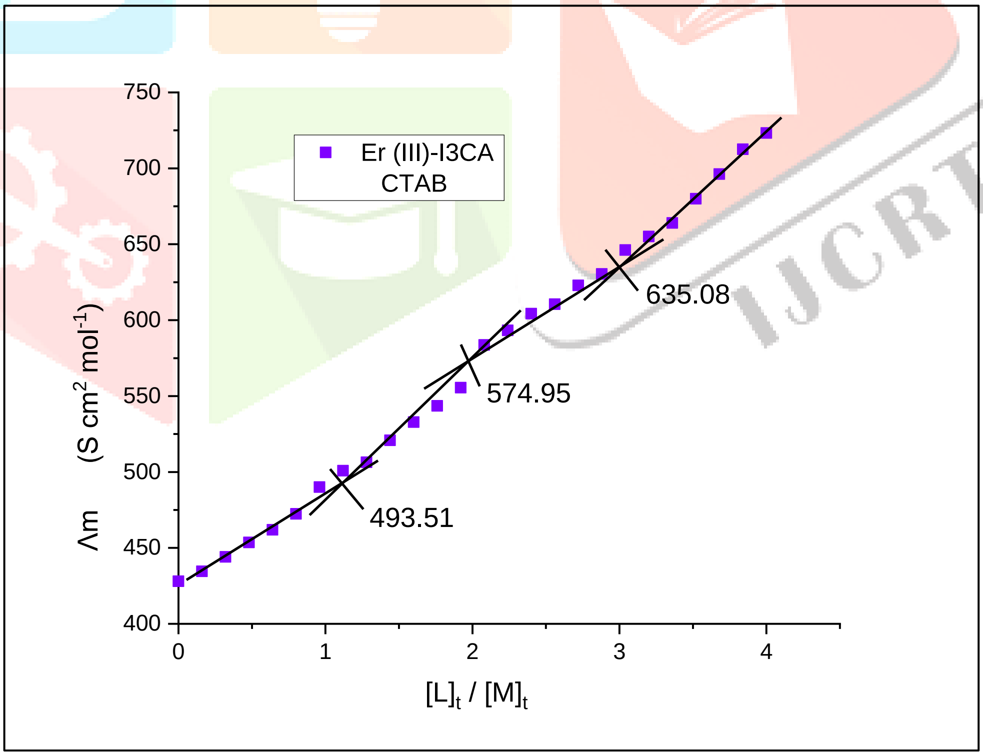

Figure-2 Graph between Molar conductance Λ_m (S cm^2 mol^{-1}) versus I3CA/Erbium(III), $[L]_t$ /$[M]_t$ at temperature 298 K in CTAB medium.

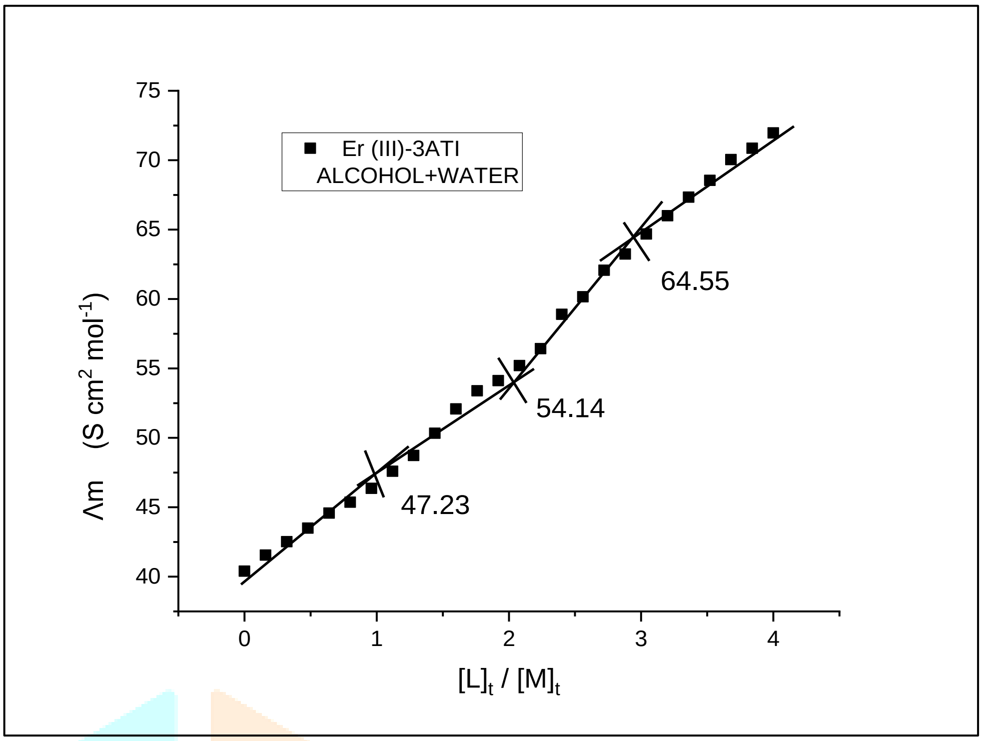

Figure-3 Graph between Molar conductance Λ_m (S cm^2 mol^{-1}) versus 3ATI/Erbium(III), $[L]_t$ /$[M]_t$ at temperature 298 K in Alcohol+water medium.

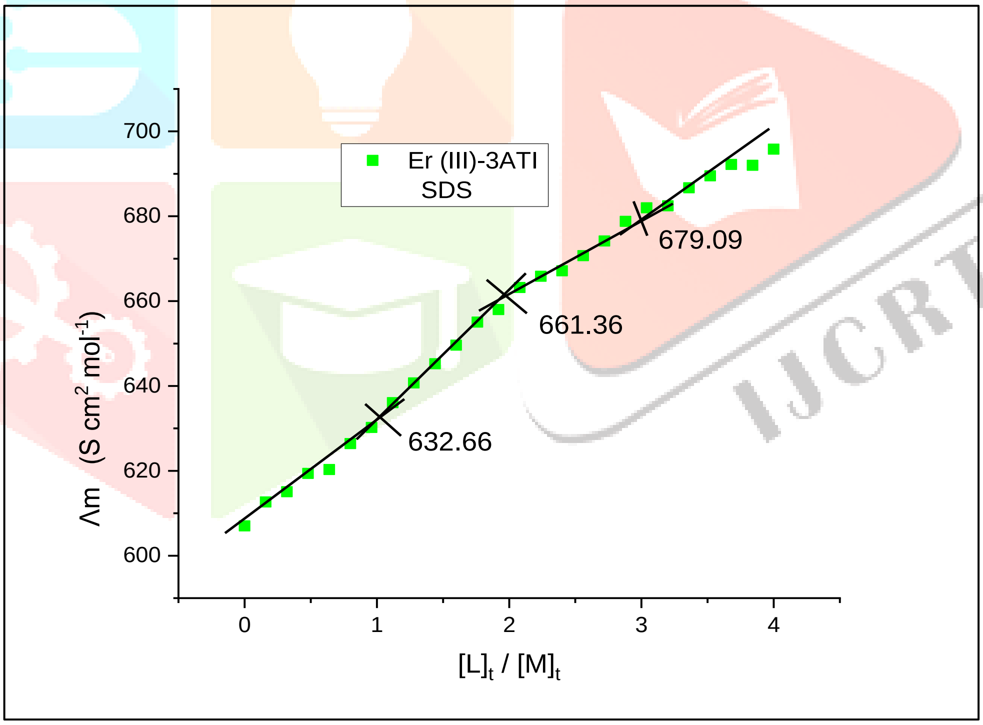

Figure-4 Graph between Molar conductance Λ_m (S cm^2 mol^{-1}) versus 3ATI/Erbium (III), $[L]_t$ /$[M]_t$ at temperature 298 K in SDS medium.

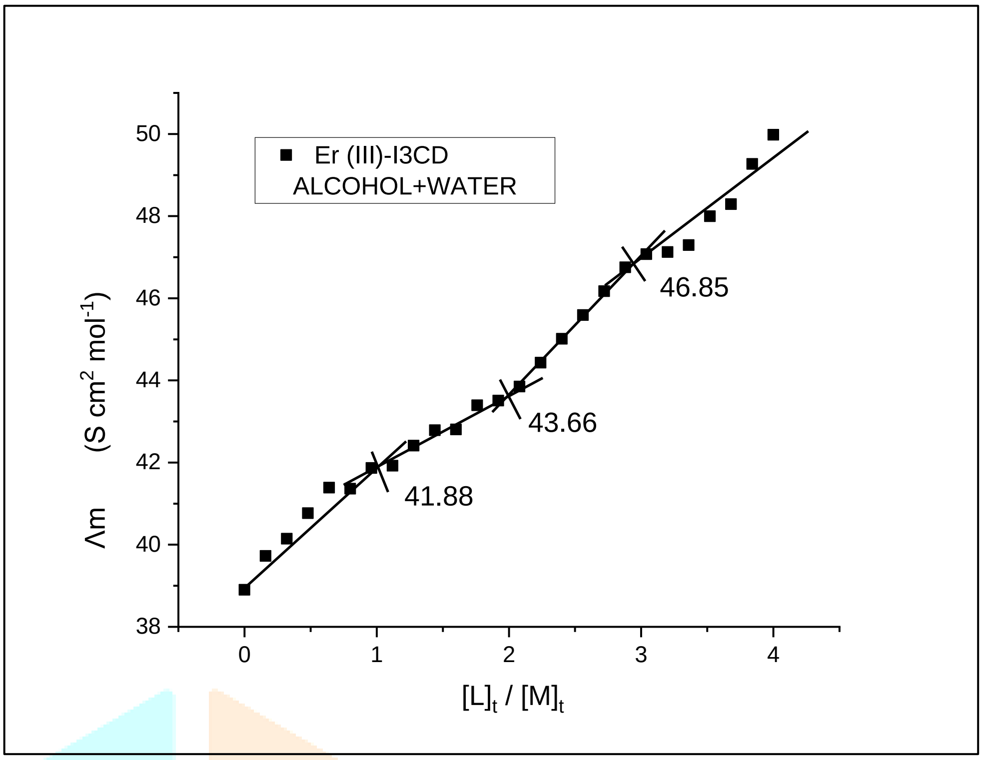

Figure-5 Graph between Molar conductance Λ_m (S cm^2 mol^{-1}) versus I3CD/Erbium(III), $[L]_t$ /$[M]_t$ at temperature 298 K in Alcohol+water medium.

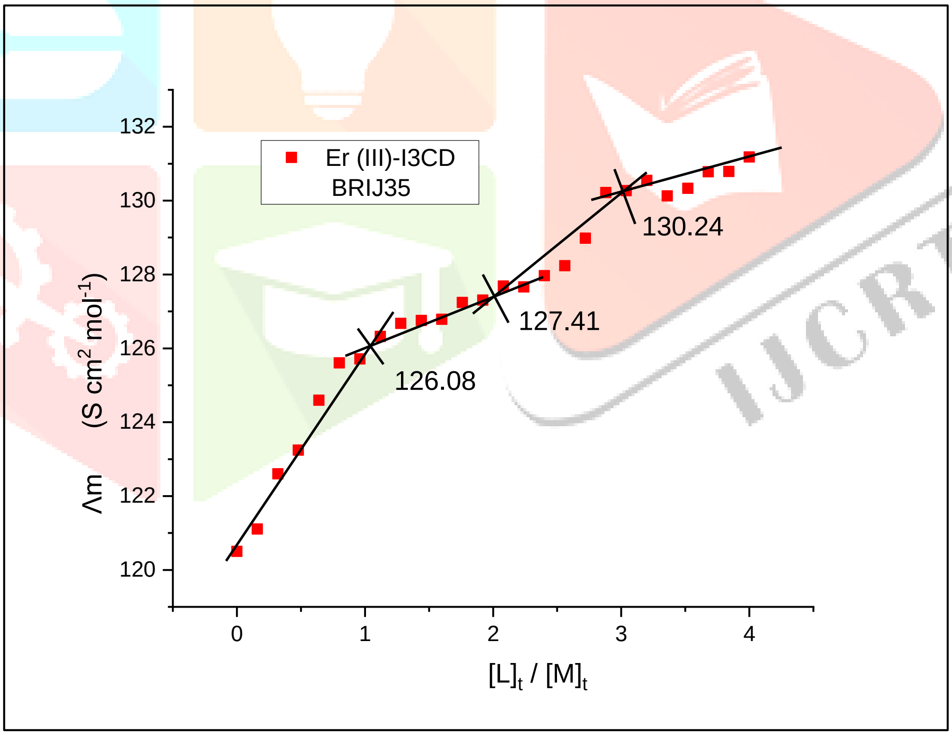

Figure-6 Graph between Molar conductance Λ_m (S cm^2 mol^{-1}) versus I3CD/Erbium(III), $[L]_t$ /$[M]_t$ at temperature 298 K in BRIJ35 medium.

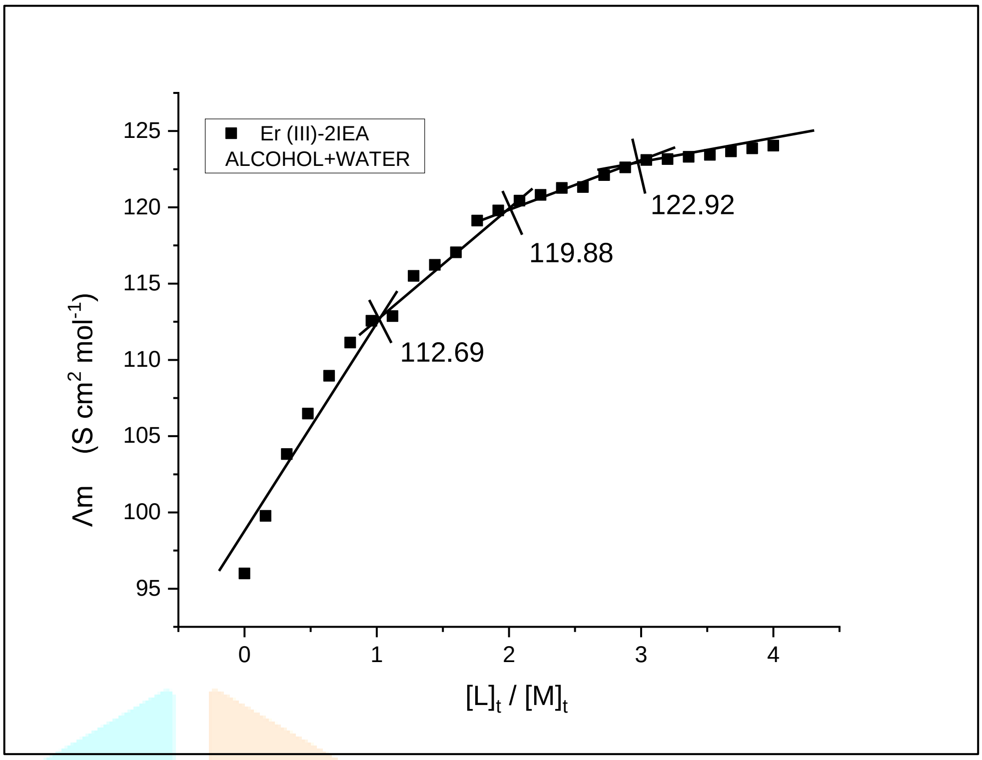

Figure-7 Graph between Molar conductance Λ_m (S cm^2 mol^{-1}) versus 2IEA/Erbium(III), $[L]_t$ /$[M]_t$ at temperature 298 K in Alcohol+water medium.

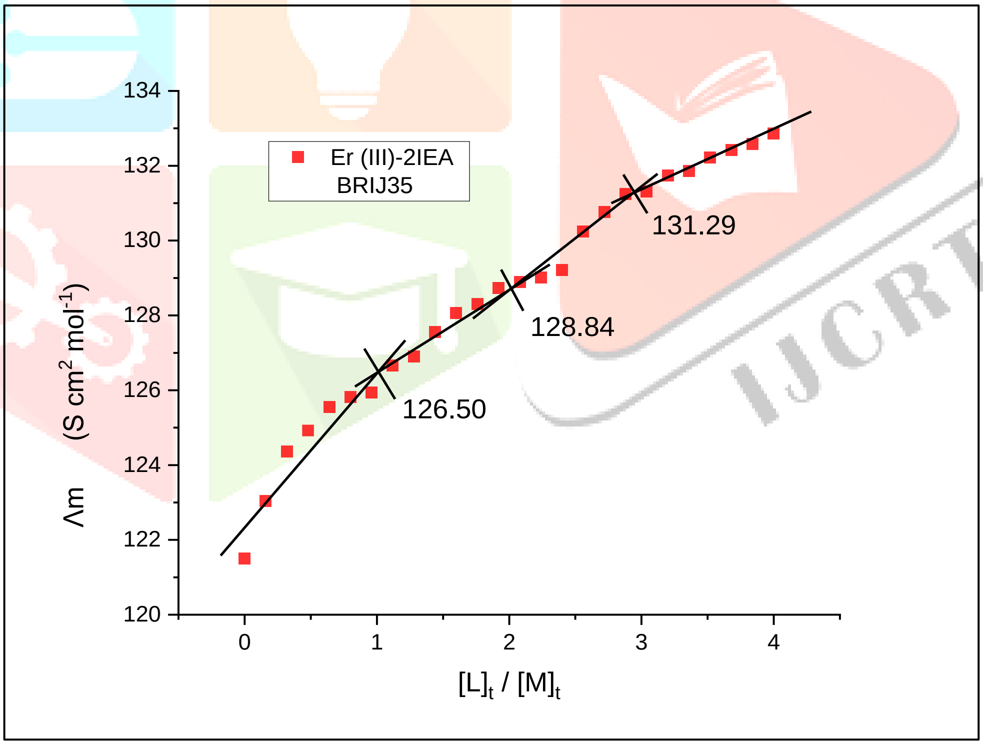

Figure-8 Graph between Molar conductance Λ_m (S cm^2 mol^{-1}) versus 2IEA/Erbium(III), $[L]_t$ /$[M]_t$ at temperature 298 K in BRIJ35 medium.

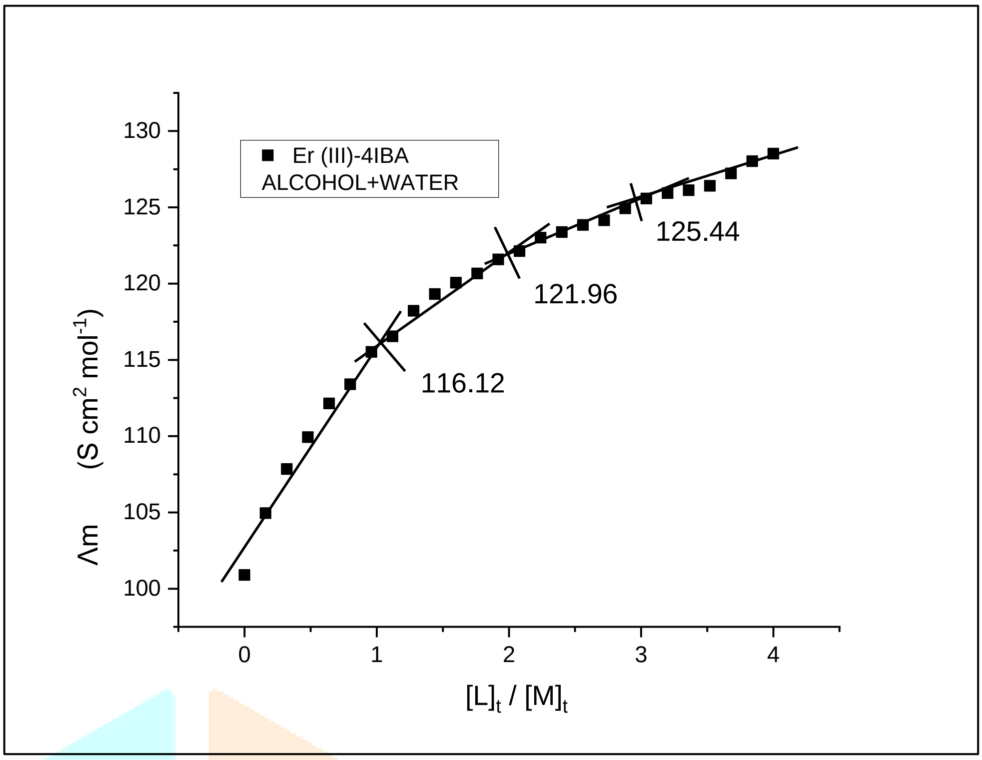

Figure-9 Graph between Molar conductance Λ_m (S cm^2 mol^{-1}) versus 4IBA/Erbium(III), $[L]_t$ /$[M]_t$ at temperature 298 K in Alcohol+water medium.

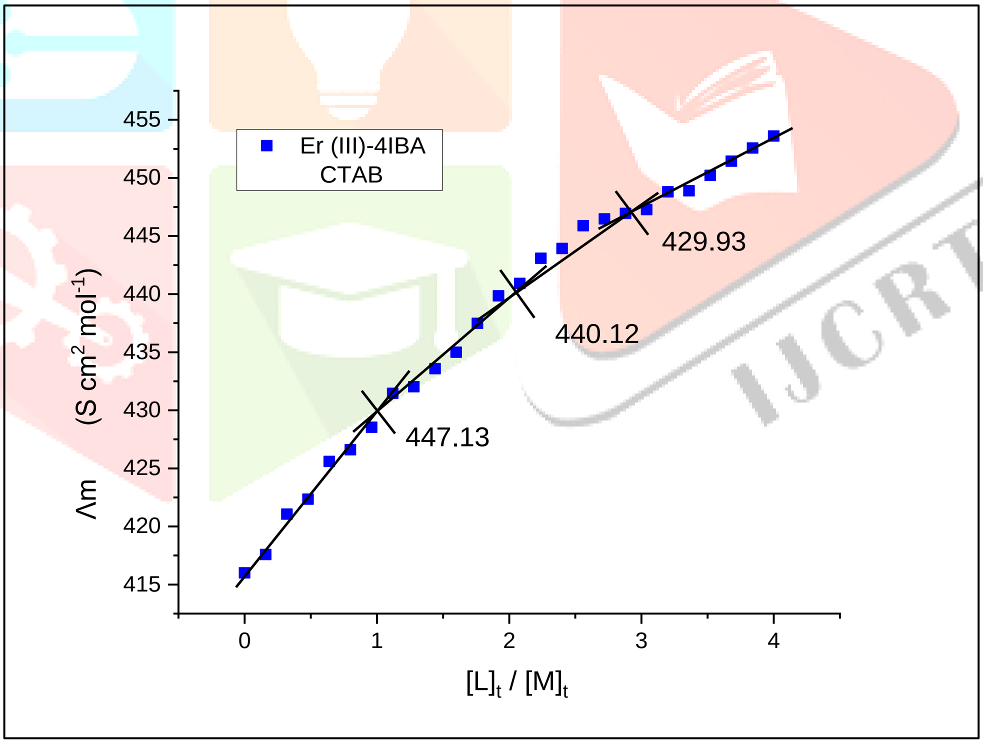

Figure-10 Graph between Molar conductance Λ_m (S cm^2 mol^{-1}) versus 4IBA/Erbium(III), $[L]_t$ /$[M]_t$ at temperature 298 K in CTAB medium.

3.3 TABLE-1 FOR AVERAGE K_A AND AVERAGE ΔG_A OF Er(III)-INDOLE DERIVATIVES IN (ALCOHOL+WATER) AND (BRIJ35/SDS/CTAB)

METAL-LIGAND SYSTEMS	AVERAGE $C_{m[Metal]}$	AVERAGE $C_{L[Ligand]}$	AVERAGE K_A	AVERAGE ΔG_A (kJ/mol)
Er(III)-I3CA (ALCOHOL+WATER)	0.00083549	0.00164507	1818912.97	-34.41306898
Er(III)-I3CA (CTAB)			780722.7702	-32.90489941
Er(III)-3ATI (ALCOHOL+WATER)			942769.527	-33.26343959
Er(III)-3ATI (SDS)			93025.29187	-28.03501487
Er(III)-I3CD (ALCOHOL+WATER)			230972.6227	-30.31322486
Er(III)-I3CD (BRIJ35)			41579.50939	-26.07514927
Er(III)-2IEA (ALCOHOL+WATER)			94422.42023	-27.68491488
Er(III)-2IEA (BRIJ35)			49881.53837	-26.59352535
Er(III)-4IBA (ALCOHOL+WATER)			108417.3354	-28.26166105
Er(III)-4IBA (CTAB)			48028.41095	-26.41746721

3.4 TABLE-2 FOR AVERAGE STABILITY CONSTANT $\log K_f$ AND AVERAGE GIBBS FREE ENERGY OF FORMATION ΔG_f oF Er(III)-INDOLE DERIVATIVE SYSTEMS IN DIFFERENT MEDIUM AND [M:L] RATIO

ERBIUM(III)-INDOLE DERIVATIVES SYSTEMS	AVERAGE $\log K_f$ OF DIFFERENT [M:L] RATIO			AVERAGE ΔG_f OF DIFFERENT [M:L] RATIO		
	[1:1]	**[1:2]**	**[1:3]**	**[1:1]**	**[1:2]**	**[1:3]**
Er(III)-I3CA (ALCOHOL+WATER)	3.74696	3.37953	2.88816	-21.3796	-19.2831	-16.4794
Er(III)-I3CA (CTAB)	3.84829	3.37497	2.77169	-21.9578	-19.2571	-15.8148
Er(III)-3ATI (ALCOHOL+WATER)	3.87457	3.23748	2.85366	-22.1077	-18.4726	-16.2826
Er(III)-3ATI (SDS)	3.58286	3.35201	2.86067	-20.4433	-19.126	-16.3226
Er(III)-I3CD (ALCOHOL+WATER)	4.04558	3.3142	3.01756	-23.0835	-18.9103	-17.2177
Er(III)-I3CD (BRIJ35)	3.79886	3.29643	3.29783	-21.6757	-18.8089	-18.8169
Er(III)-2IEA (ALCOHOL+WATER)	3.42804	3.16256	3.24502	-19.5599	-18.0451	-18.5156
Er(III)-2IEA (BRIJ35)	3.78423	3.51522	2.97432	-21.5922	-20.0573	-16.971
Er(III)-4IBA (ALCOHOL+WATER)	3.53009	3.37514	3.01773	-20.1422	-19.2581	-17.2187
Er(III)-4IBA (CTAB)	3.63695	3.19995	2.88269	-20.7519	-18.2584	-16.4482

4. CONCLUSION

This conductometric study reveals the interaction between metal and ligand Er(III)-I3CA , Er(III)-3ATI , Er(III)-I3CD , Er(III)-2IEA and Er(III)-4IBA complexes and interaction of these complexes with the non-micellar solvent systems Alcohol+Water and non-ionic, cationic and anionic surfactant micellar solvent system. It is inferred that in micellar surfactant system more interaction of solvent system with Er(III)-I3CA , Er(III)-3ATI , Er(III)-I3CD , Er(III)-2IEA and Er(III)-4IBA complexes have been observed. Extent of interaction of Er(III) with indole derivatives shown by negative value of thermodynamic parameter ΔG_A. The result of $\log K_f$ and ΔG_f are finer in cationic, anionic and non-ionic surfactant micellar systems CTAB, SDS, BRIJ35 respectively compared to non-micellar medium Alcohol+Water. The value of formation constant $\log K_f$ follow the order as $\log K_f$ (1:1) > $\log K_f$ (1:2) > $\log K_f$ (1:3) and the value of the Gibbs free energy of formation ΔG_f follow the order ΔG_f (1:1) > ΔG_f (1:2) > ΔG_f (1:3) for [M : L] ratio in their respective medium.

High negative values of ΔG_f confirm the formation of stable and spontaneously formation of complex between metal ion Erbium(III) and indole derivatives. It is inferred on the basis of value of ΔG_f that formation of more stable complexes between metal-ligand takes place when the metal ligand concentrations are in 1:1 ratio as compared to 1:2 and 1:3 ratio. Micellar system enhances the stabilization of the complexes by increasing the hydrophobic stabilization of water molecule. By using micellar surfactant medium in conductometric titration stability of metal-ligand complexes of Er(III) with (I3CA, 3ATI, I3CD, 2IEA, 4IBA) can be magnify which is observed that these complexes Er(III)-I3CA , Er(III)-3ATI , Er(III)-I3CD , Er(III)-2IEA and Er(III)-4IBA have higher value of $\log K_f$ and ΔG_f in micellar surfactant medium as compared to non-micellar medium except some specific [M:L] ratio. For detection of metal-ligand complexes conductometric titration is highly sensitive as well as inexpensive technique. The use of eco-friendly micellar medium BRIJ35, CTAB , SDS in conductometric titration are greener chemicals which are non-toxic and safer for sustainable environment and ecosystem.

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