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DOPED STUDIES FOR PHYSICOCHEMICAL PARAMETERS OF Ho(III) COMPLEXES WITH AMIDE GROUP CONTAINING LIGANDS IN DIFFERENT MEDIUM

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Abstract: Holmium (III) complexes with three aminopyridine derivatives as ligands have been investigated for intensity parameters in alcoholic and micellar medium. Triton X-100 surfactant used for micellar medium. The Electronic spectra were recorded in ultraviolet-visible range. The maximum value of oscillator strength in alcoholic medium was 91.88, while the maximum value in micellar medium was 0.9519 for Holmium complex with N2P4HB**.**

Keywords: Physicochemical Parameters**,** micellar medium, ultraviolet-visible range.

I. INTRODUCTION

Holmium is a relatively soft and malleable silvery-white metallic element that is relatively corrosion-resistant and stable in dry air at room temperature. Because holmium has the highest magnetic strength of any element, it is used for the pole pieces of the strongest static magnets. At room temperature, holmium is paramagnetic, but at temperatures below 19 K, it becomes ferromagnetic.

Holmium has one of the highest magnetic moments known. It has been used as a magnetic pole piece or "magnetic flux concentrator" to generate the strongest artificially generated magnetic fields when placed within high-strength magnets. Bult et al. described the fabrication and in vitro testing of a nano particle device containing holmium acetylacetonato for the treatment of unresectable solid tumours [1]. Moore et al. investigated the NIR lifetime determination in solution for a Ho3+ complex, which is rarely emissive because its electronic structure allows for highly competitive nonradiative deactivation [2].

Becker et al. explained the temperature-dependent evolution of spectral intensities and line widths in terms of vibronic coupling between f-f transitions and the vibrational motion of Ho (III) ions. However, the phenomenological -parameters do not change significantly with increasing temperature [3]. Dang et al studied some ternary lanthanide complexes and their corresponding sol-gels hybrid materials formed via in situ synthesis process. Judd Ofelt analysis discussed the radiative properties of Ho3+ ion in gel, indicating 5F5I6 transition as a possible candidate for optoelectronics [4].

The oscillator strengths, transition rates, and branching ratios associated with known and potential trivalent holmium laser transitions are discussed. The average oscillator strength of laser transitions between the $^5F_5$ and $^5I_5$ energy manifolds is found to be abnormally low, and an alternative explanation for the laser observation is proposed [5].

II. EXPERIMENTATION

Standard solution of the Ho (III) metal has been prepared by dissolving appropriate amount of its perchlorate in distilled water. Holmium oxide (Himedia laboraties private limited, Mumbai, India.) of 99.9% purity was used Triton–X-100 was used to provide micellar medium. Triton-X-100 (1.8 x 10-2 M, 100 CMC) is a non-ionic surfactant. Three amino derivatives taken as ligands are as follows: -

1. N-(2′-pyridyl)-4-hydroxybenzamide (N2P4HB)
2. N-(2′-pyridyl)-3,5-dinitrobenzamide (N2P3,5DB)
3. N-(2′-pyridyl)-4-carboxamide but-1-oic acid (N2P4C1BA)

EC Double beam UV-VIS Spectrophotometer with quartz cell of 10 mm light path was used for electronic spectral measurement at Green Chemistry Research Centre, P.G. Dept. of Chemistry, Govt. Dungar college (NAAC A-Grade) Bikaner, (Raj.)

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The absorption spectra of each system were recorded in various medium i.e. in alcoholic medium and in micellar medium intensity parameters include oscillator strengths and Judd-Ofelt intensity ( ) parameters. Calculation of parameters done as given in literature [6]

Table - 1
Computed values of oscillator strength (P X 10^6) for Holmium complexes of aminopyridine derivatives in alcoholic and micellar medium

S.No.	Compounds	P_{exp}	P_{cal}	P_{exp}	P_{cal}	P_{exp}	P_{cal}	P_{exp}	P_{cal}	P_{exp}	P_{cal}	P_{exp}	P_{cal}
1.	N2P4HB (Alcoholic)	91.88	-0.18	43.04	3.65	19.99	-1.72	35.25	-2.77	31.39	-1.52	7.75	-0.02
2	N2P4HB (Micellar)	0.951	-0.57	56.15	-16.96	50.19	-4.18	50.61	-6.86	55.71	-3.90	48.20	-0.05
3	N2P3,5DB (Alcoholic)	82.01	0.07	32.35	-2.67	13.31	0.67	35.33	1.58	26.44	1.33	6.41	0.01
4	N2P3,5DB (Micellar)	89.12	0.22	70.41	-18.35	60.47	2.63	68.03	3.95	56.91	1.93	50.40	0.03
5	N2P4C1BA (Alcoholic)	81.08	-0.43	41.84	10.09	19.31	-3.95	35.33	-7.38	15.17	-5.03	6.43	-0.05
6	N2P4C1BA (Micellar)	65.41	-0.11	46.64	-20.88	43.46	-0.26	47.72	0.42	55.91	1.03	51.92	-0.01

Table - 2
Computed values of T_λ and T_4 / T_6 parameters for Holmium complexes of aminopyridne derivatives in alcoholic and micellar medium

S.No.	Compounds	T_2x10^{10}	T_4x10^{10}	T_6x10^{10}	T_4/T_6
1	N2P4HB (Alcoholic)	0.804	0.912	-2.4	-0.378
2	N2P4HB (Micellar)	-5.55	1.9	-5.85	-0.325
3	N2P3,5DB (Alcoholic)	-1.3	7.6	0.94	0.8
4	N2P3,5DB (Micellar)	-4.6	-1.9	3.6	-0.542
5	N2P4C1BA (Alcoholic)	3.65	-0.24	-5.50	0.044
6	N2P4C1BA (Micellar)	-7.32	2.06	-3.77	-5.48

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Table - 3
Maximum and Minimum spectral parameters for
Ho (III) complexes of aminopyridine derivatives in alcoholic medium

S.No.	Spectral Parameters	Maximum		Minimum	
		Ligand	Value	Ligand	Value
1	T_2	N2P3,5DB	-1.3×10^{-10}	N2P4C1BA	-7.32×10^{-10}
2	T_4	N2P4C1BA	2.06×10^{-10}	N2P3,5DB	-1.9×10^{-10}
3	T_6	N2P3,5DB	3.6×10^{-10}	N2P4HB	-5.85×10^{-10}
4	T_4 / T_6	N2P4HB	-0.3255	N2P4C1BA	-5.48

III. RESULTS AND DISCUSSION

In the case of Ho^{3+}, six bands were observed and recorded in the ultraviolet-visible range of 300 nm to 900 nm. In computing oscillator strength values, the value half band width was determined by resolving the observed bands into a Gaussian shape curve, which allowed for better investigations of different parameters.The oscillator strength(P) values for Ho^{3+} complexes are of the order of 10^{-6}, indicating that the transitions are forbidden. The ligand has a large influence on the intensity of the hypersensitive transition in Ho^{3+} complexes. Higher oscillator strength (P) values indicate less symmetry in complexes [7]. The spectral intensities of observed bands are reported in terms of T_2, T_4 and T_6 parameters. Theoretically, Henrie and Choppin [8] demonstrated that of the T_2, T_4, and T_6 parameters, T_2 should be the most sensitive to the environment. The consistency of the T_4/T_6 ratio indicates a similar stereoenvironment around the lanthanide ion, whereas the dissimilarity in the above ratio indicates that complexes do not have a similar symmetry. This reflects the fact that rare earth ions may have different coordination numbers in complexes [9]. The higher P and parameter values of salt solutions in comparison to metal aqueous show the involvement of a metal ion's 4f-orbital. These parameters also show higher values with more soluble salts [10]. The negative value of the T_2 parameter is meaningless. This could be due to the appearance of the f-d transition in the visible region, or it could be compensation for the excessively large oscillator strength computed for T_4 and T_6 parameters [11].Table 1and 2 shows the intensity parameters for Ho (III) aminopyridine complexes. The value for oscillator strength is found to be greater in alcoholic medium than in micellar medium. The maximum value of oscillator strength in alcoholic medium was 91.88, while the maximum value in micellar medium was 0.9519 for Holmium complex with N2P4HB.

IV. CONCLUSION

The current study describes six doped Ho (III) systems in alcohol and micellar medium. Each system's solution spectra were recorded in the UV-Visible range. The spectral parameters of these doped systems were evaluated using their spectral data. Different intensity parameters and bonding parameters were computed. Calculations were performed using the partial and multiple regression methods.On the basis of computed data comparative investigations of Oscillator strength have been described with respect to ligands and medium.

For Ho (III)-aminopyridine systems in alcoholic medium
N2P4HB > N2P3,5DB > N2P4C1BA

For Ho (III)-aminopyridine systems in micellar medium
N2P4HB > N2P3,5DB > N2P4C1BA

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