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# USE OF ELECTRON SPECTRA IN DETERMINING THE COORDINATION NUMBER OF CENTRAL ATOMS OF COMPLEX COMPOUNDS BASED ON Ni(II) AND Co(II) IONS

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**Abstract**: This article presents ideas on the identification of the central ion that forms the complex in complex compounds of nickel and cobalt with a coordination number of six.

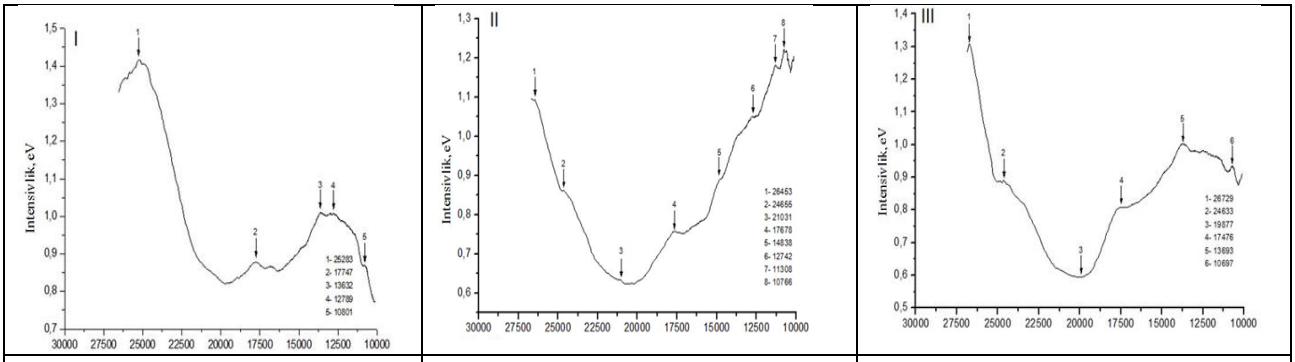
**Keywords:** Coordination number, Ni(II),Co(II) complexes, electronic spectra, electronic configuration, octahedral complex, spin-orbital

**Introduction.** During the last decade, metal complexes have attracted much attention due to their biological activity, mainly due to the need to gain insight into the electron transport pathways in biological systems and to obtain useful information about the state of the molecule-based polarities. Metal complexes of ligands have been considered as compounds, which are considered to be responsible for their semiconducting properties. As such, vitamin $B_{12}$ bio-functions are analyzed as model compounds. In this work, metal complexes of multifunctional ethylenediamine-β-propionic acid have been prepared and spectrally characterized. The ligand and its metal complexes have shown significant biological activity. Metal complexes of fluorine-containing β-diketones have also been characterized.

Most complex compounds of cobalt have a coordination number of six . have a high spin electron configuration , their ground state is 4T1g and spin-orbital interactions are significant. There are three theoretically recognized transitions in this group of complexes [1]:

$^4T_{1g}(F) \rightarrow {}^4T_{2g}$, $^4T_{1g}(F) \rightarrow {}^4A_{2g}$ and $^4T_{1g}(F) \rightarrow {}^4T_{1g}(R)$. The $^4T_{1g}(F) \rightarrow {}^4A_{2g}$ transition is two-electron and is not observed. The line at ~ 20,000 $cm^{-1}$ of the octahedral complex is said to be related to $^4T_{1g}(F) \rightarrow {}^4T_{1g}(R)$. The formation of the shoulder is caused by the spin-orbital interaction losing identity in the excited state of 4 T 1g (R). Another line at 8350 cm -1 corresponds to the $^4T_{1g}(F) \rightarrow {}^4T_{2g}$ transition. The DQES of Co(EDA- β -Pk) GATFAT ·$H_2O$ has peaks and bends at 25283, 17747, 13642, 12789 and 10801 $cm^{-1}$ [2] . The electronic spectrum of Co(EDA- β -Pk) GATFAT ·2$H_2O$ has bends and peaks at 26543, 24655, 21031, 17678, 14838, 12742, 11308 and 10766 $cm^{-1}$.

**Research method and preliminary analyses** . The coordination compound Co(EDA- β -Pk) GATFAT ·3$H_2O$ has maxima and bends at 26729, 24633, 19877, 17476, 13693 and 10697 $cm^{-1}$.




| Co(EDA- b -Pk) GATFATE ·$H_2O$ | Co(EDA- b -Pk) GATFAT · 2 $H_2O$ | Co(EDA- b -Pk) GATFAT · 3 $H_2O$ |
|---|---|---|

**Fig 1.** Electronic spectra of coordination compounds of cobalt (II) formate

Preparation of metal complexes of ethylenediamine-β-propionic acid Much research has been conducted on.

**a-normal method**: metal complexes were prepared by the elemental method. Monohydrate of Ni(II), Co(II), Cu(II), Zn(II) acetates was added with stirring to 25 ml of an equimolar solution of ethylenediamine-β-propionic acid solution (25 ml). The metal was added to a heated solution of acetate and ethylenediamine-β-propionic acid. The resulting mixture was stirred for 2 h and the resulting complexes were filtered, washed three times with warm solution of C and dried under vacuum in the presence of $P_2O_5$. The analytical data, spectral data of Tables 1 and 2 are consistent with the proposed structures.

**b-template method: 20 ml of** methanol solution of Ni(II) acetate tetrahydrate, Co(II) acetate tetrahydrate, Zn acetate tetrahydrate, and Cu(II) acetate monohydrate were mixed with 15 ml of ethanol solution to prepare a 35 ml mixture and mixed with 25 ml of ethylenediamine-β-propionic acid solution of equimolar concentration. The resulting mixture was boiled for 2 hours.

The resulting complexes were filtered, washed three times with warm ethanol solution and dried. The elemental analyses of complexes 1-2, their electronic and vibrational spectra were compared with complexes 3-4 prepared by a simple method. The conclusions drawn from the comparison are presented in Table 1 below.

**Table 1.** Results from the comparison of complexes 1-2-3-4

| № | Rangi | M. Wt | Topildi | | | | |
|---|---|---|---|---|---|---|---|
| | | | C | H | N | O | M |
| 1-kom | Qizil | 353.0 | 30.5 | 6.61 | 14.25 | 16.3 | 15.01 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2-kom | Apelsin | 371.3 | 30.15 | 6.53 | 14.07 | 16.08 | 16.08 |
| 3-kom | Jigarrang | 350.0 | 30.07 | 6.5 | 14.03 | 16.04 | 16.3 |
| 4-kom | Sariq | 357.4 | 30.5 | 6.61 | 14.25 | 16.3 | 15.01 |

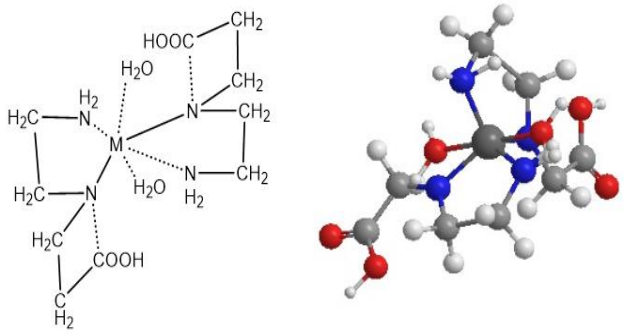



**Figure 2.** Structure and molecular model of metal complexes of ethylenediamine-β-propionic acid

This image will allow for accurate and scientifically based research and conclusions about the structure and molecular model of metal complexes of ethylenediamine-β-propionic acid.

**II. Results**: Based on the observed spectra, it can be said that the coordination number of divalent cobalt in coordination compounds with various ligands is 6, and the node geometry corresponds to an octahedron [4,8].

The octahedral complexes of nickel(II) have three absorption bands in the ranges 8000–13000, 15000–19000, and 25000–29000 $cm^{-1}$. The exact location of the lines in this band depends on the parameters D and β.

The electronic spectra of various coordination compounds of nickel(II) formate have been recorded [3] :

[Ni (EDA- b -Pk) GATFAT]·2$H_2O$, [Ni(EDA- b -Pk) GATFAT]·4$H_2O$, [Ni(EDA- b -Pk) GATFAT]·3$H_2O$.

It is evident that each spectrum contains several curves. The largest maxima were selected for line analysis. The studied complexes have three maxima in the proposed order: 25576, 16142, 10228; 26738, 16314, 10766; 26694, 16021, 10714 $cm^{-1}$, which are associated with the spin-allowed $^3A_{2g}(F)$ to $^3T_{2g}(F)$, $^3T_{1g}(F)$ and $^3T_{1g}(R)$ [5] .

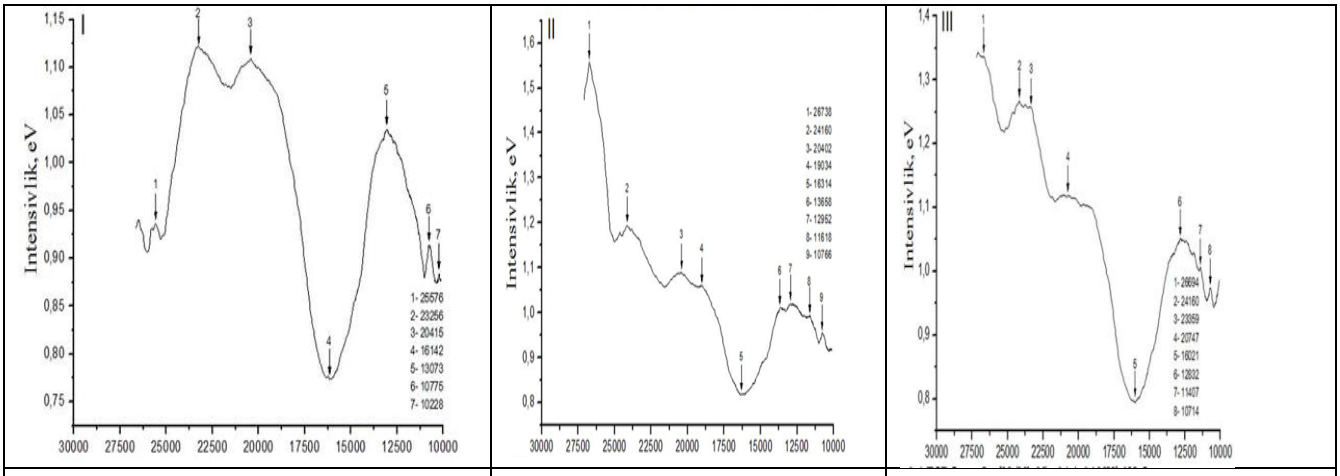
The values of Δ, β and p were calculated according to generally accepted methods. The following equation was used to calculate p:

$[6Dqp– 16(Dq)^2] +(-6Dq-p)E + E^2=0$

the $Ni^{2+}$ ion, p = 15V, where V is the Rak parameter, and for the nickel complex Ni(II) p = 15B′. The difference between the energies for the $^3R$ and $^3F$ states in the complex

changes as for the gaseous ion under covalent influence, i.e. $^3R$ serves as a measure of covalency [11].

nickel (II) formate are shown in Figure 3 below.




| [Ni (EDA- b -Pk) GATFAT]·2H $_2$ O | [Ni(EDA- b -Pk) GATFAT]·4H $_2$O | [Ni(EDA- b -Pk) GATFAT]·3H $_2$O. |
|---|---|---|

**Figure 3.** Nickel (II) formate

This image helps to accurately analyze the spectra of coordination compounds of nickel (II) formate and draw scientifically based conclusions.

**III. Conclusion** . It is seen that there is a difference between the calculated and found values of the $^3A_{2g} \rightarrow {}^3T_{1g}(F)$ energies, which indicates that the bond between the central ion and the ligand exhibits a small amount of covalence. This leads to a shift in the octahedral geometry of the coordination node [10].

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