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Synthesis and Investigating the Complexes of Some Intermediate Elements with Anthracene Carboxylic Acid Derivatives

Abstract

In this study, complexes of a few intermediate elements with derivatives of anthracene carboxylic acid are synthesized and studied. Three compounds containing the metals polarium, nickel, and copper were created in this study, and their structures were examined using IR, HNMR, mass, and ur spectroscopy. Based on mass, HNMR, UV, and IR spectra, the synthesized complexes in this study have been assessed. Based on the IR spectrum, the findings revealed that the complex structure lost its OH peak, and the carbonyl group emerged at two more frequencies. This shows that the metal and ligand are coordinated. The existence of two ligands in the palladium complex structure is shown by the number of protons in the H1NMR spectrum. We deduced that the mass and HNMR complex in the palladium complex is not created by the palladium spectrum but rather by hydrogen bonding between two ligands. It demonstrates the complex's 8-faceted structure based on the UV-visible spectrum.

Keywords: *Carboxylic anthracene, Polarium complex, Nickel complex, Copper Complex*

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Introduction

Researchers' interest in heterocycles and polycyclics has increased recently, not because of their intriguing and peculiar structure but rather because of their tremendous potential and wide variety of uses in the fields of catalysis and medicine. (1 and 2). The hydrocarbon derivative anthracene, which has three aromatic rings, is made from coal tar. It has a boiling temperature of 345 and a melting point of 218. Anthracene is insoluble in water but more soluble in organic solvents such as alcohol, benzene, chloroform, and carbon disulfide.

Anthracene has three side-by-side aromatic benzyl rings in its structure, and its usual chemical formula is CnH2n-18. Anthraquinone, which is the source of several hues and pigments, pesticides, wood preservatives, and coating compounds, is the principle of their oxidation. As a result of the reduction, anthracene yields two products, the first of which is 9 and 10 dihydroanthracene, which lacks the aromaticity of one of the side rings. There are several applications for anthracene. It serves as a semiconductor, anthracene. It is used to distinguish between high-energy photons, electrons, and their constituent particles. It is used to create plastics like polyvinyl toluene, as a pesticide, as a wood preservative, and to cover metal. Aloe vera plant contains hydroxy anthracene compounds, which are used medicinally (3).

The anthracene carboxylic acid ligand has been effectively employed in recent research for the production of complexes and may be in the form of a monomer, dimer, tetramer, hexamer, etc.; it has demonstrated high brightness and magnetic characteristics (4). Despite possessing a significant conjugated system, anthracene rings have enabled the development of luminous materials (5). Anthracene 9-carboxylic acid makes a hydrogen bond with another molecule to create a tetramer in alcoholic solutions (6).

Anthracene 9-carboxylic acid complexes have been created recently and worked with a variety of metals from the group of intermediate elements. Additionally, they have created compounds of tin with 9-anthracene carboxylic acid (7).

Many complexes, including the synthesis of manganese, copper, silver, and nickel complexes, have been created to study and characterize the impacts of anthracene rings with a big π system (8). The research's findings indicated that the anthracene rings in the ligand play a significant role in the development of these complexes with the interaction of π-π bonds and C-H interactions in the production of manganese complexes (9).

The aforementioned materials state that the purpose of this research is to synthesize and study the complexes of a few intermediate elements with a derivative of anthracene carboxylic acid.

Method

H-NMR spectra were collected in COCL3 and DMSO solvents using 500 MHZ spectrometers with TMS as an internal standard. The apparatus created IR spectra using KBr tablets. Additionally, ur and mass spectra have been developed. The anthracene 9-carboxylic acid ligand, metal salt, and methanol solvent used in this experiment were all purchased from Merck.

Complex preparation

After obtaining 1 mmol of each ligand, which contained 0.222 g and 12 ccs of methanol, and the palladium metal salt, which contained 0.266 g and 12 ccs of methanol, the salt solution was gradually added to the ligand solution. A few drops of soda were also added, and the mixture was then heated to 70°C for 20 minutes.

One mole of the ligand, weighing 0.222 g, and one mole of the palladium metal salt, weighing 0.266 g, were individually produced before being separately dissolved in 20 ml of the solvent methanol.

A few drops of soda were also added, and the ligand and methanol solution was gradually mixed with the metal salt solution. The resulting solution was then heated for 20 minutes to 70°C. In the end, a brown precipitate was produced, which was then cleaned and washed with cold methanol to prepare it for spectrometry.

For the synthesis of the copper complex, 1 mmol of the ligand, which weighs 0.222 grams, and 1 mmol of the copper metal salt, which weighs 0.241 grams and has the chemical formula CUN2O6.3H2O, were prepared. The solutions of each were then prepared separately with 20cc of methanol. The copper metal salt solution was then gradually added to the ligand solution, and the solution's color changed, indicating the reaction between them. In this instance, the solution was heated with a few drops of ammonia added, and the result was a brown coating with golden granules.

Findings

1. Studying the ligand spectrum

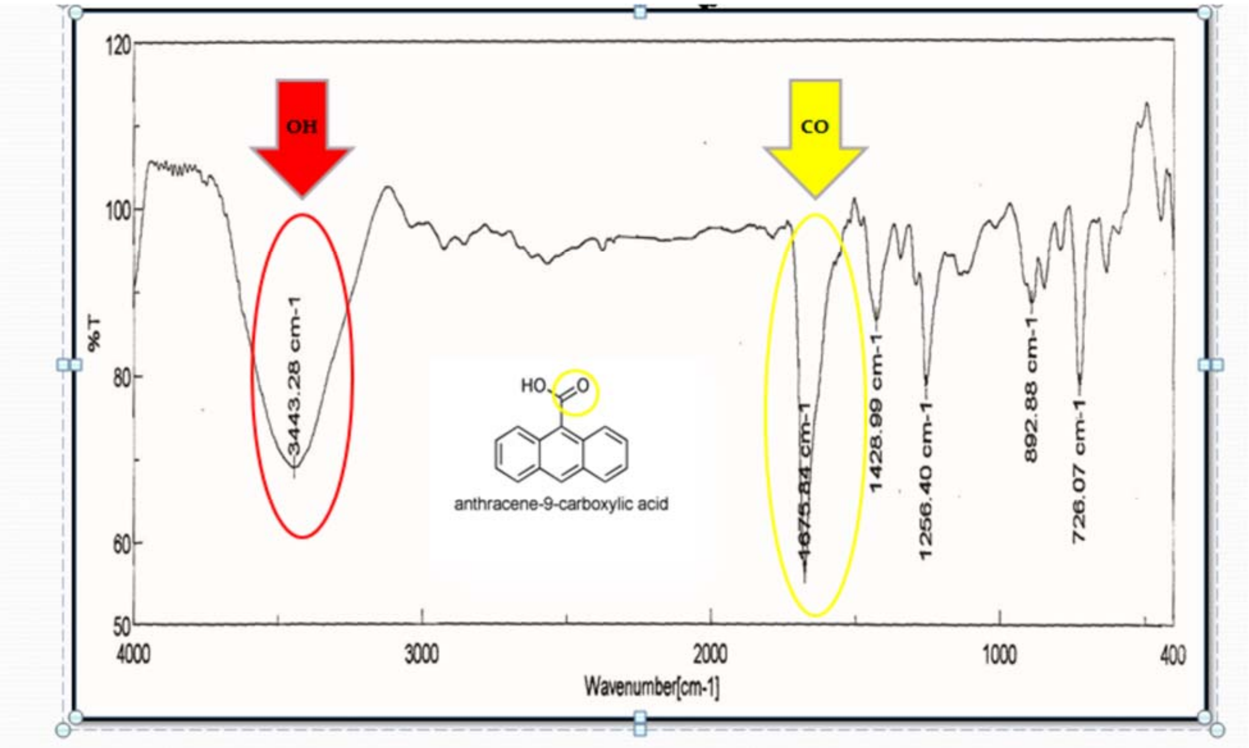

Figure 1. Interpretation of the IR spectrum of anthracene 9-carboxylic acid

The acidic OH peak is represented by a large absorption band in the ligand's IR spectra at a wavelength of 3343 cm. The CO group is indicated by the peak area of 1675 cm.

IR(KBr) : Vmax= 3443cm^{-1}, 1675cm^{-1}, 1428cm^{-1}, 1256cm^{-1}

2. Interpretation of H1NMR spectrum: Anthracene-9-carboxylic acid

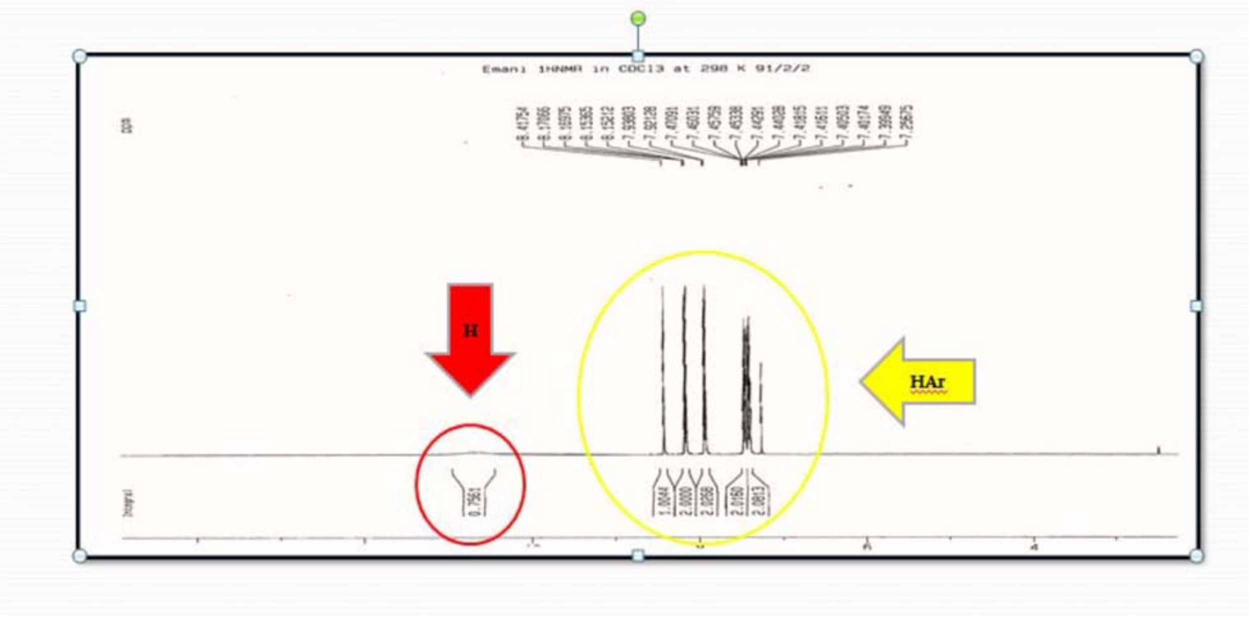

Figure 2. Interpretation of the H1NMR spectrum of anthracene-9-carboxylic acid

The structure of the ligand is confirmed by several peaks made up of aromatic hydrogens and two doublet-doublet peaks in the range of ʒ=7.38-17.8.

H.NMR(CDCl ,500MHZ) : 7 / 38 741(2H.m) 7 / 44 - 7 / 47(2H,m),7 / 62 - 7 / 63(2H,dd),8/15 -8/17(2H,dd) 8/ 41(1H,S)

3. Studying the palladium complex spectra

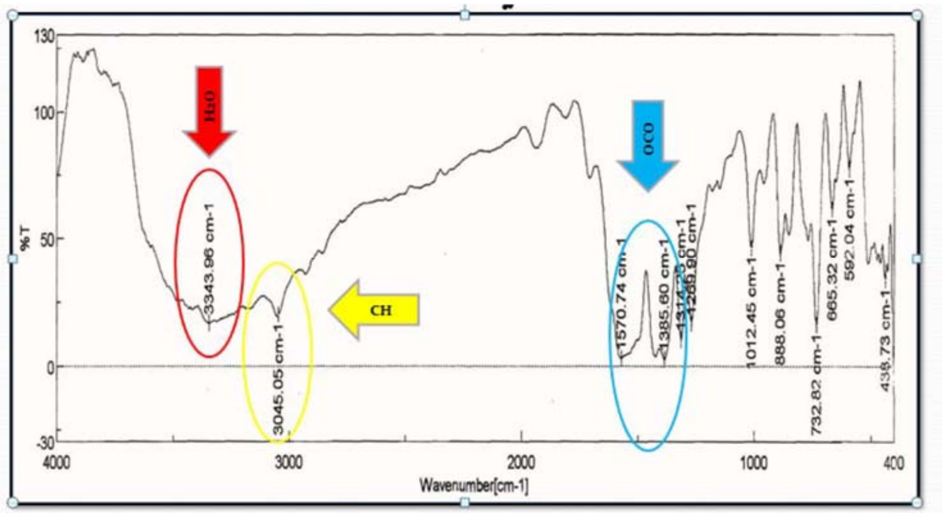

Figure 3: Interpretation of the IR spectrum of the palladium complex

The acidic OH peak is absent from the IR spectra, and two peaks in the range of 3443 cm-1 and 3045 cm-1 are present. These peaks are associated with the stretching vibrations of aromatic CHs and the vibrations of water molecules. Due to the peak associated with the vibrations of the carbonyl group being eliminated from the complex's spectra and the appearance of two peaks in the range of 1570 cm-1 and 1385 cm-1, OCO vibrations are indicated by their existence.

$$\mathrm{IR(KBr)}:\upsilon_{\max}=3343\mathrm{cm}^{-1},3045\mathrm{cm}^{-1},1570\mathrm{cm}^{-1},1385\mathrm{c}$$

4. Interpretation of H1NMR spectrum of palladium complex

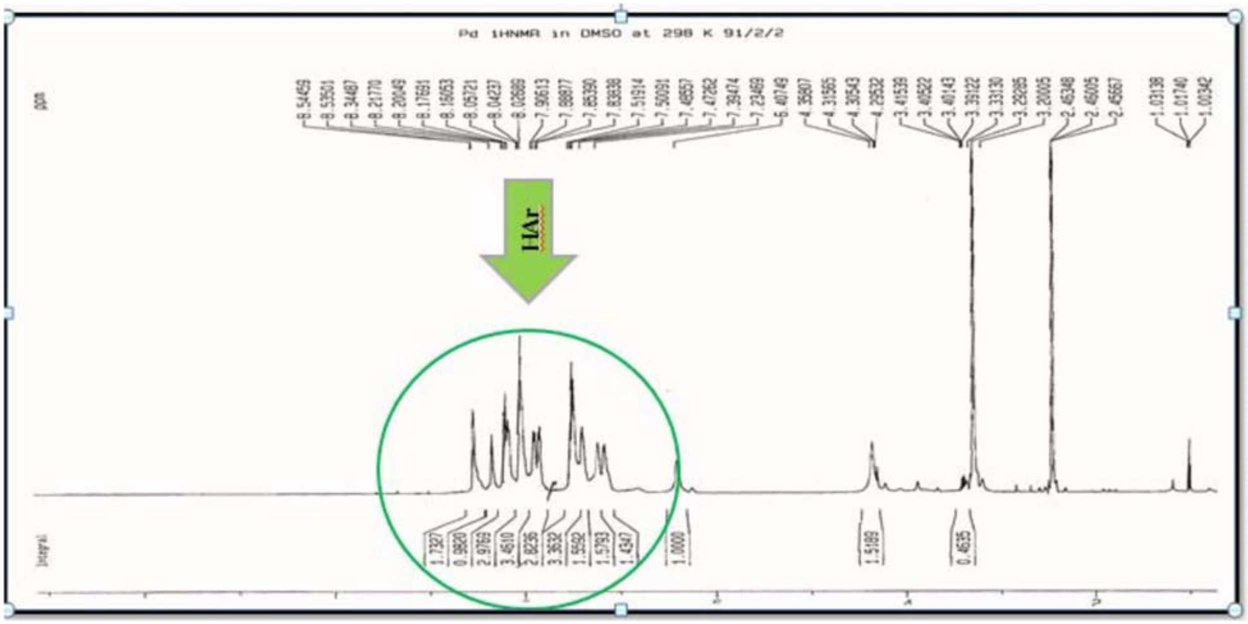

Figure 4. The interpretation of the H1NMR spectrum of palladium complex

A complex is not formed, and the two ligands are linked to one another by hydrogen bonds, as evidenced by the observation of 18 protons in the aromatic area and 2 protons in the non-aromatic region.

5. Interpretation of the UV spectrum of palladium complex

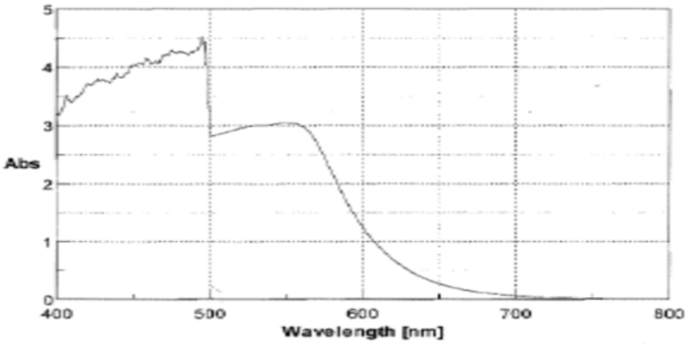

Figure 5. Interpretation of the UV spectrum of palladium complex

Only one peak of this complex's spectra has been seen, and further peaks have emerged at energies above this one.

6. Interpretation of the mass spectrum of the palladium complex

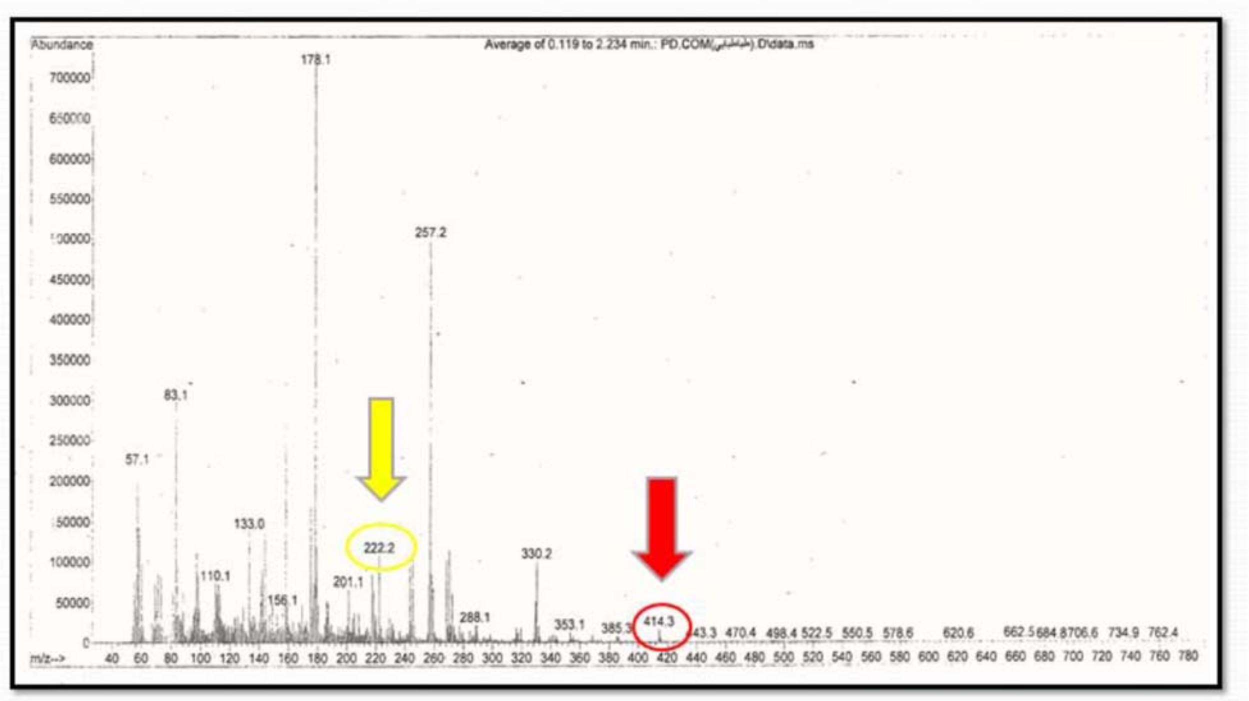

Figure 6. Interpretation of the mass spectrum of the palladium complex

The existence of 2 ligands in the product may be established based on the atomic masses of anthracene and palladium metal in the mass spectrum. That is, the structure of the end product may be demonstrated as follows based on the HNMR spectrum, where the number of protons indicates the existence of 2 ligands and 2 acidic hydrogens.

7. Studying the spectra of copper complex

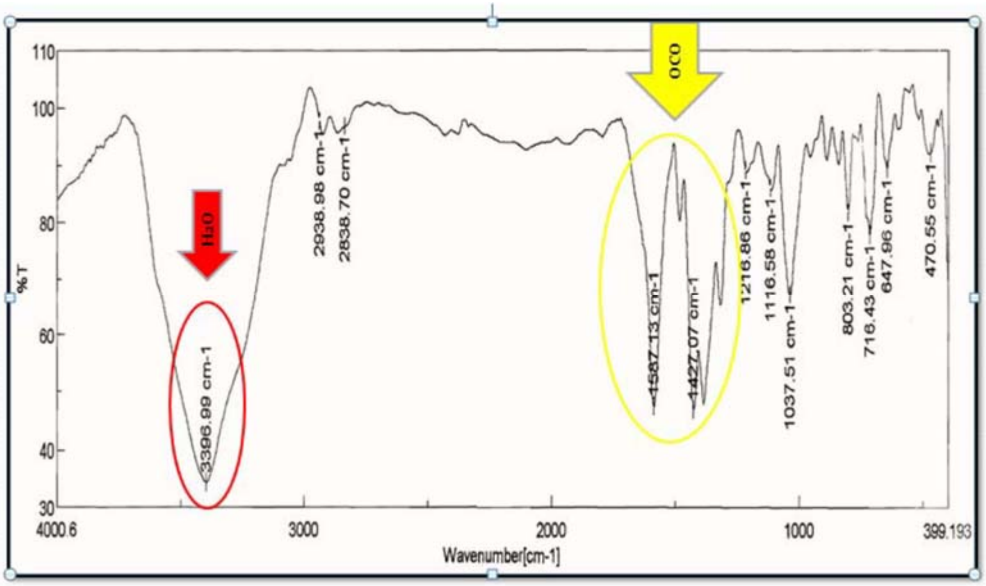

Figure 7. Interpretation of IR spectrum of copper complex

The acidic OH peak has been eliminated from the complex's IR spectra, and the presence of the peak at 3369 cm^{-1} is connected to the aromatic C-H stretching vibrations. OCO vibrations are indicated by the existence of two peaks in the vicinity of cm^{-1}1427 and cm^{-1}2587.

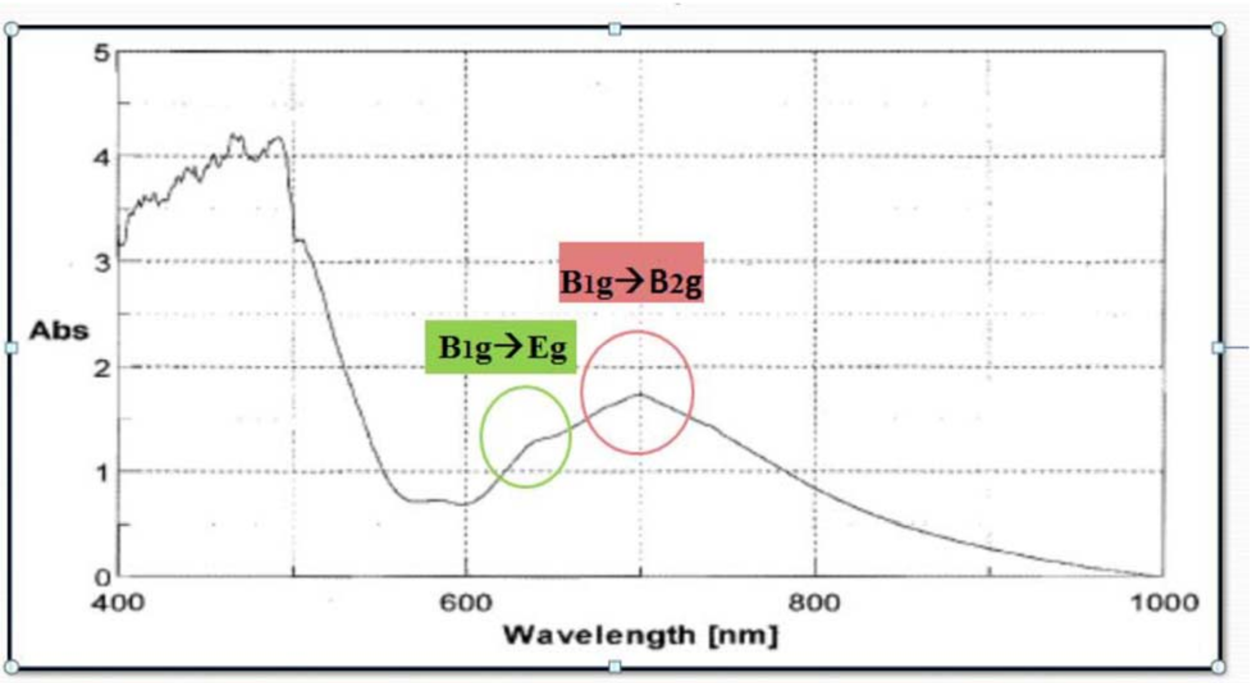

Figure 8. Interpretation of UV spectrum of copper complex

The copper complex may be predicted to be an octahedral complex with Jan Teller variation using the UV spectrum and other spectra. It is possible to think of the structure as having two ligands for anthracene carboxylic acids, two water molecules, and a complex with copper metal.

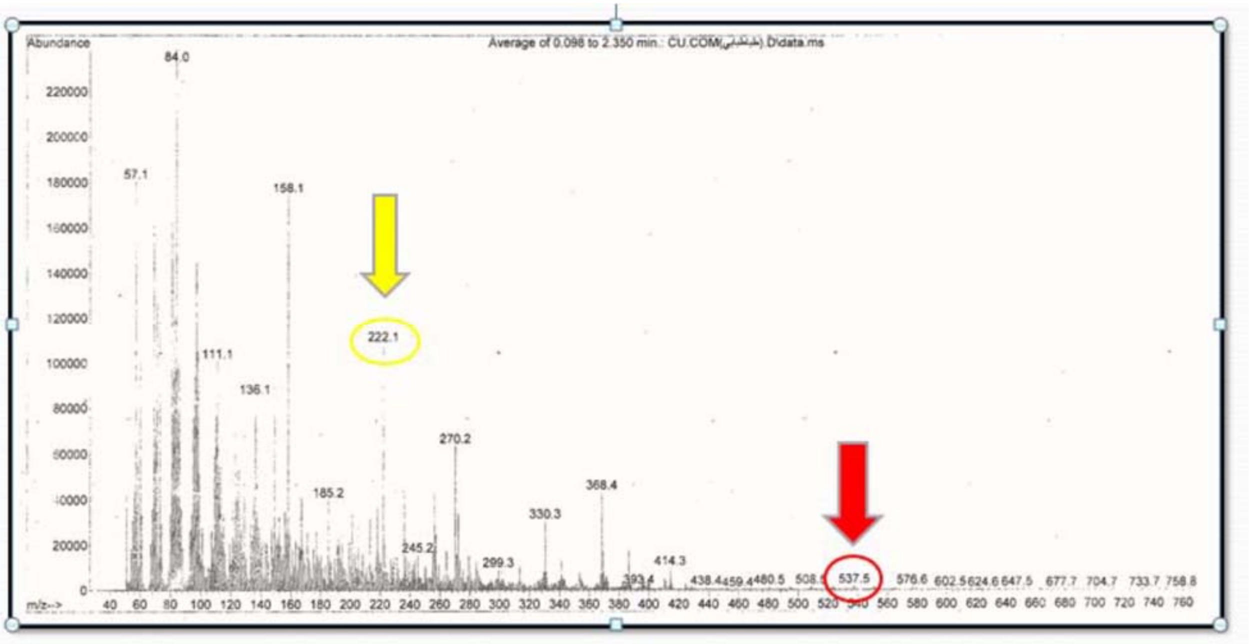

Figure 9. Interpretation of the mass spectrum of the copper complex

The existence of metal and ligand in the complex may be verified based on the atomic masses of anthracene and copper metal in the mass spectrum.

8. Investigating the spectra of nickel complexes

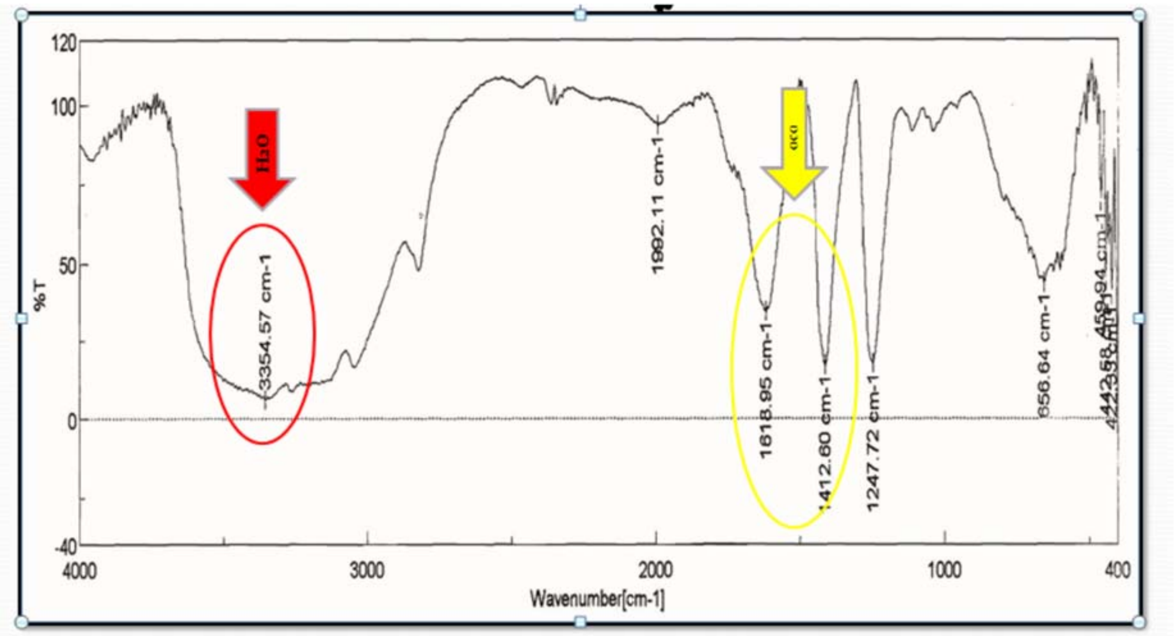

Figure 10. Interpretation of IR spectrum of nickel complex

The acidic OH peak has been eliminated from the complex's IR spectra, and the presence of a peak of about 3354 cm^{-}1 is connected to the stretching vibrations of aromatic CHs. OCO vibrations are responsible for the presence of two peaks in the vicinity of $^{-1}$ cm1618 and $^{-1}$ cm1412, which denotes the removal of the peak associated with the carbonyl group.

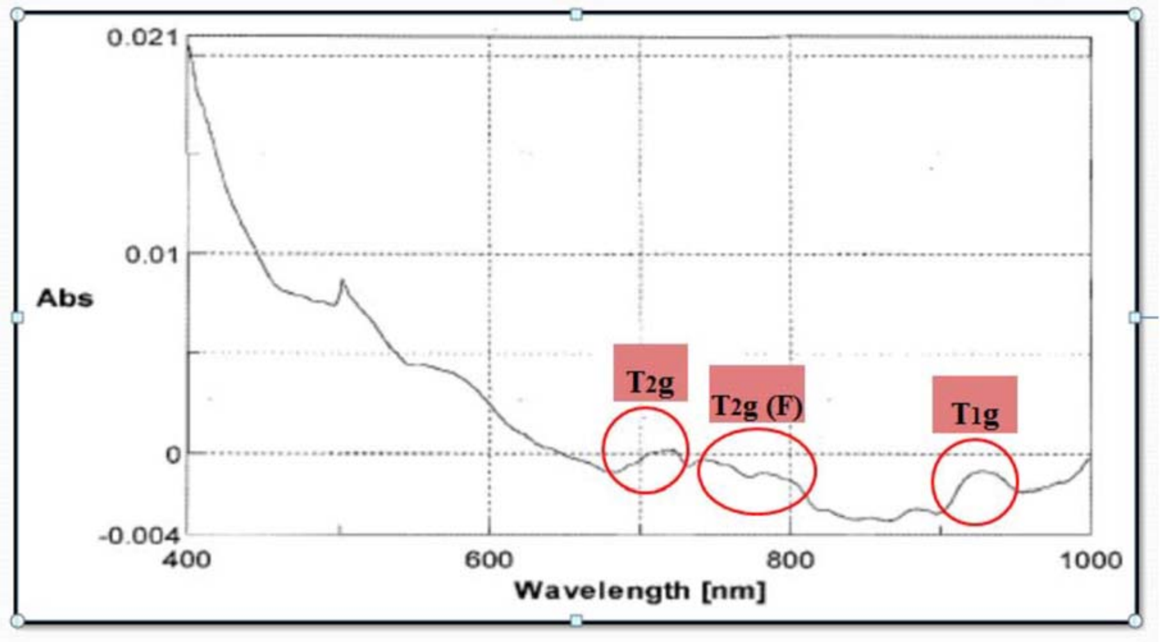

Figure 11. Interpretation of UV spectrum of nickel complex

An octahedral structure for this complex can be assumed in light of the UV spectrum and comparison with other spectra. The following are the electronic transfers in this building:

☐ $^{3}A_{2}g \rightarrow {}^{3}T_{2}g$

☐ $^{3}A_{2}g \rightarrow {}^{3}T_{1}g(F)$

☐ $^{3}A_{2}g \rightarrow {}^{3}T_{1}g(P)$

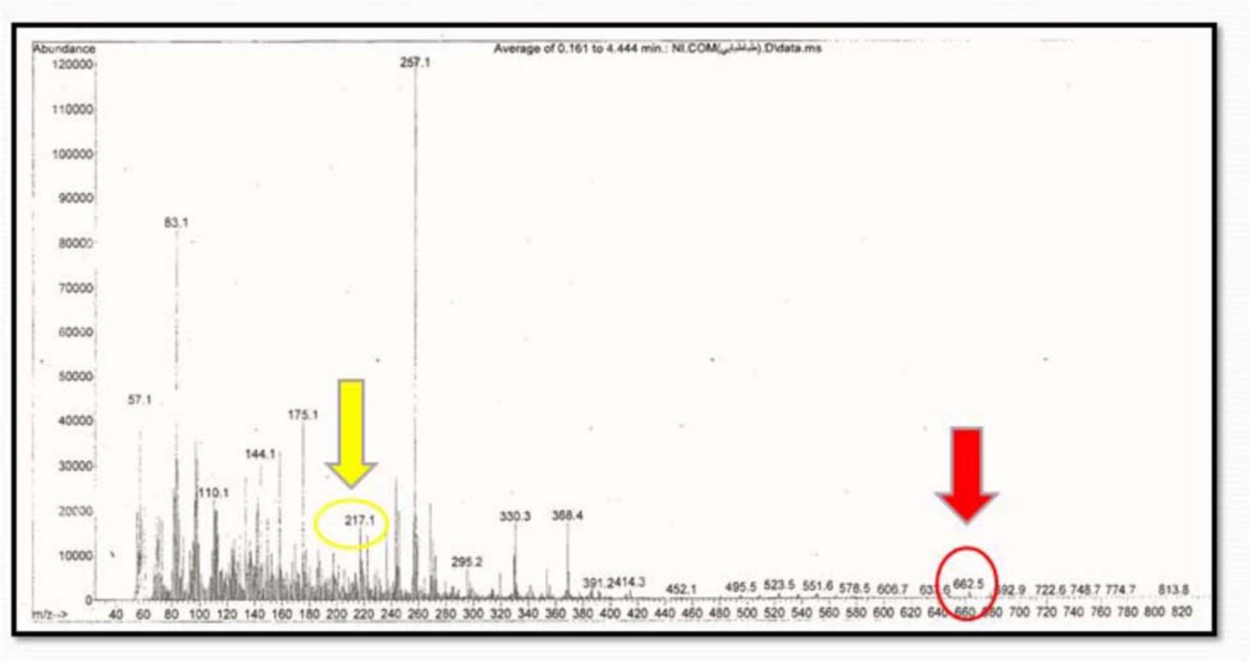

Figure 12. Interpretation of the mass spectrum of the nickel complex

The existence of metal and ligand in the complex may be verified based on the atomic masses of anthracene and nickel metal in the mass spectrum.

Discussion

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Conclusion

Based on mass, HNMR, UV, and IR spectra, the synthesized complexes in this study have been assessed. Based on the IR spectrum, the findings revealed that the complex structure lost its OH peak, and the carbonyl group emerged at two more frequencies. This shows that the metal and ligand are coordinated. The existence of two ligands in the palladium complex structure is shown by the number of protons in the H1NMR spectrum. We deduced that the mass and HNMR complex in the palladium complex is not created by the palladium spectrum but rather by hydrogen bonding between two ligands. The result may be determined using the UV-visible spectrum, which reveals the complex's 8-faceted structure. It implies that the complex's structure may be projected to look like this.

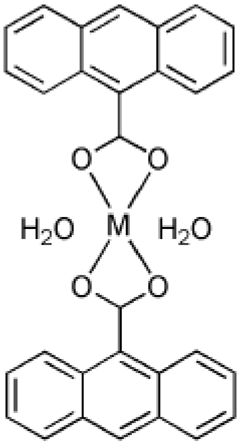

Figure 13. Octahedral structure of palladium complex

Acknowledgments

None.

Conflict of interest

None.

Financial support

None.

Ethics statement

None

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