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THE SYNTHESIS OF NEW METAL COORDINATION COMPOUNDS BASED ON 2-AMINO-1,3,4-THIADIAZOLE AND THEIR IR SPECTROSCOPIC ANALYSIS

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The synthesis of metal coordination compounds has been a significant area of interest in the field of inorganic chemistry [1]. The incorporation of ligands such as 2-amino-1,3,4-thiadiazole (ATD) into metal complexes is particularly noteworthy due to the presence of nitrogen and sulfur donor atoms, which can coordinate with various metal ions, offering unique properties for various applications. These complexes have been studied for their catalytic, antibacterial, and electrochemical activities [2]. The primary goal of this research is to synthesize new metal coordination compounds based on 2-amino-1,3,4-thiadiazole and analyze their structural properties using Infrared (IR) spectroscopy [3]. The IR spectra of these complexes provide valuable insights into the coordination modes of the ligand and the interactions between the metal center and the ligand [4].

The metal coordination compounds were synthesized by reacting 2-amino-1,3,4-thiadiazole (ATD) with metal salts such as $CuCl_2 \cdot 2H_2O$, $CoCl_2 \cdot 6H_2O$, $Ni(CH_3COO)_2 \cdot 4H_2O$, and $Zn(CH_3COO)_2 \cdot 2H_2O$ in an ethanolic solution. The reactions were carried out under slightly basic conditions (pH 7.5–8.0), and the resulting complexes were isolated as solid products. The synthesis was carried out according to the following general procedure: A solution of ATD (2 mmol) in ethanol was prepared;. A solution of the corresponding metal salt (1 mmol) was prepared separately; Both solutions were mixed under stirring, and the pH was adjusted to approximately 8 using sodium acetate buffer; The mixture was heated for 1–2 hours, followed by cooling to room temperature; The resulting solid complex was filtered, washed with ethanol and water, and dried in an oven at 50 °C.

The yields of the metal complexes were in the range of 70–85%.

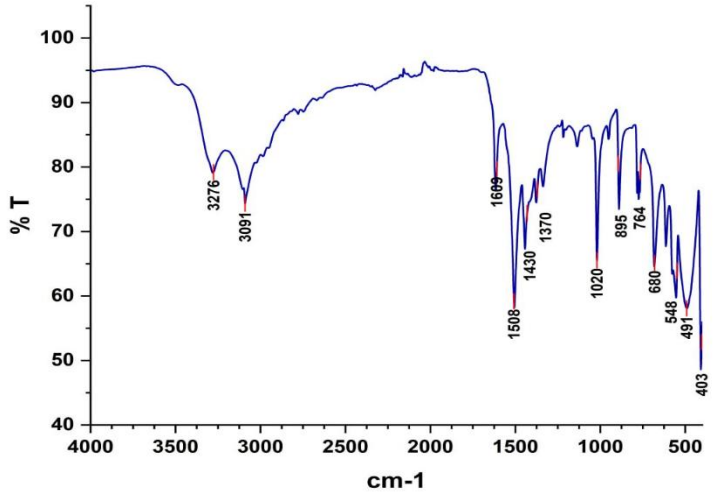

Fig.1. IR spectrum of 2-amino-1,3,4-thiadiazole.

The synthesized metal coordination compounds were characterized by various techniques, with a focus on Infrared (IR) spectroscopy. The IR spectra of the complexes revealed important information about the coordination of 2-amino-1,3,4-thiadiazole with metal ions. The following observations were made: ν(NH_2)_stretch: The stretching vibrations of the NH_2 group were observed at around 3400 cm^{-1}, with two prominent peaks, indicating the presence of the amino group in the complex; ν(C=N)_ring: The C=N stretching vibrations associated with the imino group were observed at around 1600 cm^{-1}, which shifted slightly compared to the free ligand, confirming coordination to the metal; ν(N–N): The N–N stretching vibrations were detected around 1020 cm^{-1}, which is characteristic of the thiazole ring. This band shifted slightly in the complexes, further supporting coordination; ν(C–S): The C–S vibrations were observed in the region of 720–780 cm^{-1}, with shifts indicating the involvement of sulfur in coordination; The characteristic metal-ligand stretching frequencies (ν(M–N) and ν(M–S)) were observed in the range of 420–560 cm^{-1} for M–N and 250–420 cm^{-1} for M–S, indicating successful coordination of the metal center to both nitrogen and sulfur atoms in the ligand. These findings are consistent with the formation of bidentate (N,S) coordination

complexes.

The complexes were also analyzed for stability, and no significant degradation was observed up to temperatures of 250 °C, as evidenced by thermogravimetric (TG) and differential thermal analysis (DTA) results.

In conclusion, the synthesis of new metal coordination compounds based on 2-amino-1,3,4-thiadiazole was successfully achieved. The IR spectral analysis provided valuable insights into the coordination mode of the ligand and the interaction between the metal ions and the donor atoms (N and S). The results confirmed the formation of stable bidentate coordination complexes, which hold promise for various applications, including catalysis and bioactivity. Further studies will focus on evaluating the bioactivity and electrochemical properties of these complexes.

References

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