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INFRARED SPECTROSCOPIC ANALYSIS OF COMPLEXATION BETWEEN 5-AMINO ISO-PHTHALIC ACID, COBALT NITRATE, AND ETHYLENEDIAMINE

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Abstract

This study investigates the complexation process between 5-amino iso-phthalic acid (IPA), cobalt nitrate, and ethylenediamine (EDA) using Fourier-transform infrared (FTIR) spectroscopy. The observed vibrational shifts in the spectrum provide evidence of functional group coordination and the formation of a stable metal-ligand complex. The results demonstrate changes in the vibrational frequencies of carboxylate, amino, and cobalt-related bonds, confirming structural modifications during the interaction.

Keywords: cobalt nitrate, acid,

Introduction

5-Amino iso-phthalic acid is an aromatic dicarboxylic acid with applications in polymers, dyes, and pharmaceuticals due to its ability to coordinate with metals. Cobalt nitrate, a commonly used transition metal salt, forms coordination complexes with various ligands. Ethylenediamine (EDA), a bidentate ligand, effectively stabilizes metal complexes due to its dual coordination sites. This study aims to analyze the structural and vibrational changes during the formation of a coordination complex between IPA, cobalt nitrate, and EDA using FTIR spectroscopy.

Materials and Methods

Materials:5-amino iso-phthalic acid (purity > 99%), cobalt nitrate hexahydrate, and ethylenediamine were purchased and used without further purification.

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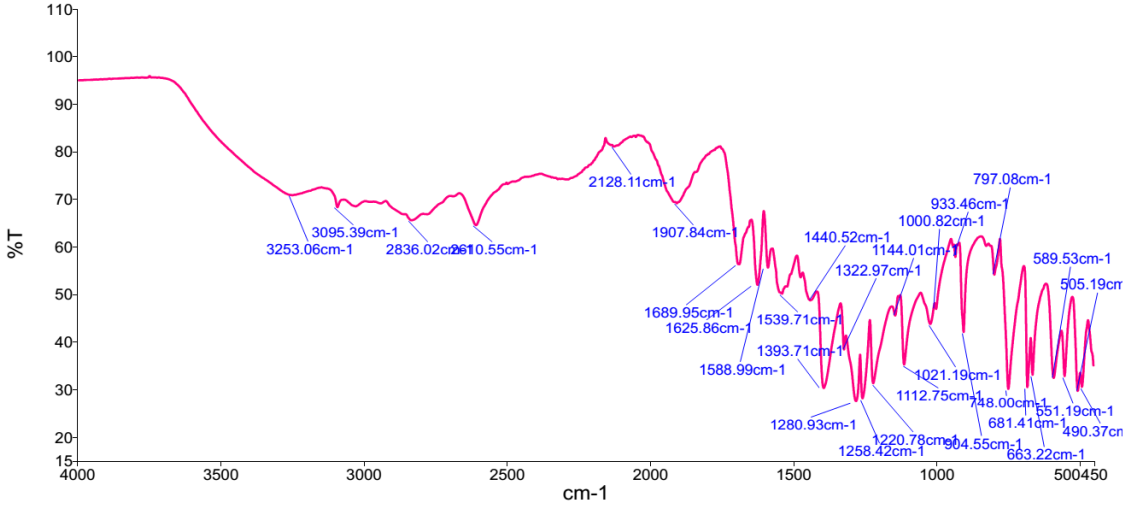
Synthesis of the Complex: Equimolar solutions of 5-amino iso-phthalic acid and cobalt nitrate were mixed and stirred at room temperature. Ethylenediamine was gradually added to the solution until a homogeneous mixture was achieved. The reaction was carried out at [specific temperature and duration]. The precipitate was filtered, washed, and dried under vacuum.

FTIR Spectroscopy:The IR spectra of the pure compounds and the synthesized complex were recorded using a [spectrometer model] in the range of 400–4000 cm^{-1} with a resolution of 4 cm^{-1}.

Results and Discussion.

Complex Formation: The spectral changes strongly support the formation of a coordination complex between IPA, cobalt nitrate, and EDA. The results suggest that both carboxylate groups and ethylenediamine coordinate with cobalt, forming a stable complex.

FTIR Spectrum Analysis



The FTIR spectrum of the synthesized complex (shown in the figure) reveals significant shifts and the appearance of new peaks, confirming the formation of a coordination complex. The main observations are as follows:

1. Broad Peak at 3253–3095 cm^{-1}:

This region corresponds to O-H and N-H stretching vibrations. The broadening and intensity changes indicate the involvement of hydroxyl and amine groups in coordination.

2. Shift in Carbonyl Stretching (C=O):

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The carbonyl stretching vibration of IPA shifted from 1700 cm^{-1} (in free IPA) to 1689 cm^{-1} in the complex, suggesting coordination of carboxylate groups with cobalt ions. This is further supported by the emergence of new peaks at 500–600 cm^{-1}, indicative of Co-O bonds.

3. EDA Involvement:

N-H stretching vibrations of EDA exhibited a shift, confirming coordination through nitrogen atoms. Deformation vibrations in the 1258–1300 cm^{-1} range further support EDA's role in stabilizing the complex.

4. New Peaks in the Metal-Ligand Region:

Peaks at 505–589 cm^{-1} represent Co-O and Co-N bonds, confirming the formation of a coordination network between cobalt, IPA, and EDA.

5. Other Key Vibrations:

Peaks at 1440–1258 cm^{-1} correspond to aromatic C=C stretching and confirm the preservation of the aromatic backbone in the complex. Additional peaks at 933–797 cm^{-1} are attributed to out-of-plane vibrations, indicative of structural reorganization.

Conclusion

Infrared spectroscopic analysis confirms the formation of a coordination complex between 5-amino iso-phthalic acid, cobalt nitrate, and ethylenediamine. The shifts in vibrational frequencies of carboxylate, amine, and metal-oxygen bonds demonstrate significant structural and electronic interactions during complexation.

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