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RESEARCH ARTICLE

Synthesis and characterization of cadmium(II) complexeswith some thiosemicarbazone ligands

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Abstract

Four cadmium complexes $[Cd(BTSC)_2Cl_2]$, $[Cd(BTSC)_2(CH_3COO)_2]$, $[Cd(FTSC)_2Cl_2]$ and $[Cd(FTSC)_2(CH_3COO)_2]$ have been synthesized and characterized by elemental analysis, electrical conductance and spectral studies. The conductance data indicate that the four complexes behave as nonelectrolytes because in these complexes the anions are not free and are coordinated to the central metal ion and also show diamagnetism. From IR studies, it was observed that the complexes have metal to sulphur co-ordination which is an important factor showing their capability to be used as precursors for metal suphide nanoparticles and the complexes possess octahedral geometry.

Keywords

cadmium complexes
Elemental analysis
Electrical conductance
Sulphur co-ordination
Octahedral geometry

Introduction

Coordination chemistry [1] which is the chemistry of metal complexes plays a vital role in industry, technology and life process. It has always fascinated and inspired chemists all over the world. This can be evidenced by the prolificity and scope of research papers on the subject in the recent times and also by the diversity in which it has found application. The impressive revival in the field coordination chemistry during the last few decades is mainly due to the advent of modern analytical techniques such as different spectroscopic methods and thermal analysis [2-5]. The invention of newer version of equipment's for spectroscopic and thermo analytical studies made the study of metal complexes easier [6,7]. Use of computers enormously simplified the interpretation of X-ray crystallographic and magnetic data. Cadmium is a soft, silvery, white, easily fusible metallic element. It is present in the environment in the form of complex oxides, sulphide and carbonates and is formed with ores of zinc, lead and copper in the nature. Cadmium tarnishes in air and is soluble in acid but not in alkali. It is slightly soluble in water. Cadmium is used in a number of industries and founds application in welding, soldering, photography, etc and in the manufactures of iron, steel and cement. Most of the application of cadmium is in rechargeable batteries and used as a red pigment. The present investigation deals with the synthesis and characterizationof some cadmium(II) complexes derived from furfuralde thiosemicarbazone and benzaldehyde thiosemi, carbazone. The complexes of thiosemicarbazone ligands assume importance

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Because of the recent observations about the antibacterial and antitumor activities of some thiosemicarbazones and a few their metal complexes. The antimicrobial activity of thiosemicarbazone which comprises a well-known group of nitrogen and sulphur donors has been extensively used for complex formation. The complexes were assigned by investigating elemental analysis, electrical conductance and IR spectral studies. Here we used cadmium as the metal and so the suitability for their use as therapeutic agents does not come into picture. But these cadmium thio complexes like these have found many uses in Nanochemistry. Many reports have come regarding the use of similar complexes as single source precursors for nanoparticles. Nano sized cadmium chalcogenides have applications as photo conductors and in many other fields.

Experimental

All the chemicals used were of Analar grade cadmium chloride, cadmium acetate, furfuraldehyde, benzaldehyde and thiosemicarbazone were obtained in Merck.

Preparation of ligands

FURFURALDEHYDETHIOSEMICARBAZONE (FTSC)

Hot solution of 1 g of thiosemicarbazide in 25 mL ethanol was added dropwise to a refluxing mixture of 1.0541 g of furfuraldehyde in 25 mL ethanol in a round bottom flask and refluxed further for 2 h on a water bath. The mixture was cooled to room temperature while the crystals of thiosemicarbazone were separated which was filtered, washed with dilute ethanol and dried.

BENZALDEHYDETHIOSEMICARBAZONE (BTSC)

Hot solution of 1 g of thiosemicarbazide in 25 mL ethanol was added dropwise to a refluxing mixture of 1.1685 g of benzaldehyde in 25 mL ethanol in a round bottom flask and refluxed further for 2 h on a water bath. The mixture was cooled to room temperature while the crystals of thiosemi carbazone were separated which was filtered, washed with dilute ethanol and dried.

Preparation of complexes

The well powdered ligand is dissolved in ethanol and heated gently on a water bath. The metal salt solution is warmed and added mixture was refluxed for about 2 h. The colour changes at once indicating the formation of complexes. The solid complex separated was removed by filtration, washed thoroughly with ethanol and dried. The following complex are also prepared in this way.

1 Complexes of cadmium(II) chloride with furfuraldehyde-thiosemicarbazone [CCFTSC]
2 Complexes of cadmium(II) acetate with furfuraldihyde-thiosemicarbazone [CAFTSC]
3 Complexes of cadmium(II) chloride with benzaldehyde-thiosemicarbazone [CCBTSC]
4 Complexes of cadmium(II) acetate with benzaldihyde-thiosemicarbazone [CABTSC]

Physical measurements

The IR spectra of the ligands and their complexes were recorded in potassium bromide pellets in the range 4000-400 cm^{-1} on a Perkin Elmer FT-IR spectrophotometer. Magnetic susceptibility measurements were made using Gouy balance at room temperature.

Results and discussion

Molar conductance of the complex in nitrobenzene was measured at room temperature. The conductance behaviour of the complexes in nitrobenzene shows that cadmium complexes are having nonelectrolyte character.

From a scrutiny of the data it can be seen that the values of absorption due to azomethine nitrogen (C=N coordination) and thione sulphur (C=S coordination) in ligands are red shifted in complexes showing coordination *via* azomethine nitrogen and thione sulphur in the complexes. This is also confirmed by the appearance of new bands corresponding to υM-N and υM-S coordination at around 450 and 755 cm^{-1} respectively. The structure of the ligand was established with the help of IR and previous analytical data available in the literature.

Conclusions

Cadmium complexes of furfuraldehyde thiosemicarbazone and benzaldehyde thiosemicarbazone were prepared. The complexes have been characterized by elemental analysis, electrical conductance and IR spectral studies. The conductance data indicate that the four complexes behave as nonelectrolytes because these complexes the anions are not free and are coordinated to the central metal ion. From the IR studies, it was

observed that the complexes have metal to sulphur co-ordination which is an important factor showing their capability to be used as precursors for metal suphide nanoparticles. By comparing with literature from previous studies, we propose an octahedral structure to the complexes.

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