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Synthesis and Characterisation of Potassium tetra cyanonickelate $K_2[Ni(CN)_4].H_2O$ and thier interaction with Nucleotides 5'-AMP, 5'-CMP, 5'-UMP, 5'-GMP

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Abstract

Metal cynogen complex namely potassium tetracyanonickelate has been synthesized and characterized using magnetic susceptibility, TGA/DTA/ IR, CHN analysis and XRD techniques.Adsorption studies of ribose nucleotides, 5'-AMP, 5'-CMP, 5'-UMP and 5'- GMP were done IR sutdies revealed taht 5'- AMP, 5'- CUMP, 5'-CMP showed significant adsorption. One et al. (11) studied the synthesis of nickel (II) L-cystein, L-methionine, 1-Trypotphan-Nucleotide ternary complex. Ranjan et al. (10) studied the synthesis and electrochemical properties of cyanobridge copper (I) ruthenium(II) complex. Potassium tetrayano nickelate was synthesized according to the reported method (18). 60g (0.228 moles) of Nickel sulfate were added slowly to the solution of potassium cyanide (0.457 moles) with constant stirring. Brilliant red colour solution of $K_2[Ni(CN)_4].H_2O$ was formed. This solution was heated on the hot plate untill small crystals begin to form. They were redissolved and the solution was permitted to cool. The large well formed crystals were obtained. Now the precipitate was filtered under vaccum and washed several times with distilled water. These precipitates were then dried in the own at (60-70 ^{0}C) to obtain pure potassium tetracyano nickelate.

Keywords: *Absorption spectra, $K_2[Ni(CN)_4].H_2O$, C, H, N, XRD, IR*

Introduction

Nicke is one of the essential transition metal for several hydogenases and urease enzymes. Nickel does not occurs in nature in elementry form and its compounds though coidely distributed throughout the world among the rare constituents of the earth crust, it is obtained from pentlandite (Fe, Ni)$_9$ S^8, Pyrrhotite (Fes) and Millerite (NiS).

Nickels is the twenty second elements by weight in the earth's crust. Gunera properties of elements Nickel are as follows atomic number(28).

Atomic weight= 58.7, El. configuration = [Ar] $3d^8 4S^{2,}$ Covalent radius (1.15 A^0) Boiling Point (2920 ^{0}C), Melting Point (1455^{c}C), Oxidation state (II) Nickel is a silvery white metal, Ni is often electroplated on the other methods provides a protective coating. Nickel is used as a catalyst in hydrogenation reaction conversion of oil into fat. Conversion of Co and steam into Co_2 and H_2 It is also used in making alloys like, Constnan (Cu+Ni) Monel Metal (Ni + Cu+Fe), Steel (Ni +Fe). Tetracarbonyl Nickel used as catalyst as well as reagent, in organic synthesis.

Carbonyylation of alkene and alkynes called hydro carboxylation

$$R\text{-}CH=CH_2 + CO + H_2O \xrightarrow{Ni(CO)_4} R\text{-}CH_2.CH_2\text{-}COOH$$

If carbonylation reaction is carried out in an aprotic solvent the product is cyclopentenone derivative formed by intramolecular inseration of terminal double bond into acyl-nickel bond

Carbonylation of organic halides into allyl halide undego carbonylation in the presence of $Ni(CO)_4$ to afford β, γ. Unsaturated carboxylic acids

X-Ray diffraction analysis of similar cyano complex octacyanotungstate was carried out by saramaga et al. (26). Polarization absorption studies of the electronics and geometrical structure of the cyano complex of molybdenum and tungsten were made by Morys et al. (27). $K_2[Ni(CN)_4].H_2O$ potassium tetracyanonickel was found stable upto 426 ^{0}C as a straight curve. The magnetic moment of $K_2[Ni(CN)_4].H_2O$ was foudn to be 0.49 BM. this indicate the absence of any unpaired electrons and hence diamagnetic character. X-Ray diffraction studies tell different crystals have been interplanar spacing and therefore have different angles. On comparing the observed values with reported values types of regularity of arrangement of atom in crystalline compound are determined.

IR studies of $K_2[Ni(CN)_4].H_2O$ was carried out. A sharp band in the range of 2121 cm^{-1} was character istic to C≡N stretching. Another band 611 cm^{-1} M-C streeting. A band 3433 cm^{-1} was observed to interstitial water molecules present in the metal cyanogen complex.

Material and Methods

Chemical Name (Nickel sulphate), Marked by (BDH), Grade (A.R), Chemical Name (Potassium cyanide), Marked

by (Amrut Industrial Products), Grade (A.R), Chemical Name (Zinc nitrate), Marked by (Ranbaxy), Grade (A.R), Chemical Name (Copper chloride), Marked by (Merck), Grade (A.R), Chemical Name (Chromium chloride), Marked by (BDH), Grade (A.R), Chemical Name (5'-AMP), Marked by (SRL), Grade (A.R), Chemical Name (5'-UMP), Marked by (FLUKA), Grade (A.R), Chemical Name (5'-GMP), Marked by (SRL), Grade (A.R), Chemical Name (5'-CMP), Marked by (BDH), Grade (A.R),

Thermal analysis- the TGA/DTA curve were recorded on a perbin elmer (Pyris diamond) TGA/DTA high temperature instrument at Institute instrumentation centre, IIT Roorkee.

Magnetic susceptibility to determine the number of unpaired electron magnetic suspectibility measurement of the metal tetracyano nickelates were studied using vibrating sample magnetometer.

IR studies, UV-Visible spectroscopy, X-Ray dittraction, CHN analysis,

Table-1 Percentage of C, H, N of synthesized tetracyano nickelate

Compound	%H	%C	%N
$K_2[Ni(CN)_4]H_2O$	0.209	18.44	21.00

Table-2 Observation of magnetic susceptibilities of synthesized tetracyanonickelate

Compound	$R=\mu_1-\mu_2$	$W=W_1-W_2$	μcal (B.M.)	μobs (B.M_
$K_2[Ni(CN)_4]H_2O$	0.013×10^{-2}	0.06488	0	0.49

Table-3 X-Ray-Diffraction Data for $K_2[Ni(CN)_4]H_2O$

S.No.	θ value(τ)	α-Values	$I/I_0 \times 100$ (%)
1	28.983	3.25632 (3.957)*	100
2	24.977	3.56216 (3.57)*	73.26
3	14.538	6.51015 (6.16)*	98.00
4	30.816	2.89924 (2.84)*	29.00

Brackets represents the reported value

Results and Discussions

Potassium tetracyano nickelate was prepared and therefore was established by TGA/DTA and C, H, N analysis as $K_2[Ni(CN)_4]H_2O$.

Interaction of $K_2[Ni(CN)_4]H_2O$ with 5'-AMP, 5'- CMP, 5'-UMP, 5'-GMP revealed.

$K_2[Ni(CN)_4]H_2O$ the one water molecules was lost between the temperature range 25-190^{0}C in which 8% loss in weight took place. On further heating the compound was stable upto temperature 426 ^{0}C as a straight curve was obtained. On Further heating the decomposition of compound started.

DTA gives the difference in temperature between the sample and reference material as a function of temperature or time. The TGA/DTA curves of all these metal tetracyano nickelate prepared are given in Figure. For $K_2[Ni(CN)_4]H_2O$, the one water molecule was lost between the temperature. C, H, N Aanalysis through C, H N analysis potassium tetracyano nickelate percentage of carbon, hydrogen and nitrogen in complex were obtained and are given in Table. Values of observed percent, C, H and N closely matched with the theoretical calculated percentages. On the basis of C, H, N percentage number of water molecules were determined in each complex. The predicted formulae are as follow $K_2[Ni(CN)_4]H_2O$

Magnetic measurement are extremely useful in the characterization of mateirals at the microscopic level, dealing with the electronic and bulk structures and analysis of various compound.

When a crystalline substance is subjected at X-rays, crystalline substance act as diffraction grating. The wavelengths of X-rays are of the same order as the spacing between atoms in the crystalline materials.

The infrared spectral studies of potassium, nickelates have been done and corresponding spectra are shown in figures. The IR spectra of potassium tetracyano nickelates contained peak at 2100 cm^{-1}. This clearly indicates the presence of cyanide group. Also the peaks at 3433.47 cm^{-1} and 1618 cm^{-1} were due to the presence of water molecules. These peaks correspond to OH stretching and -OH bending respectively.

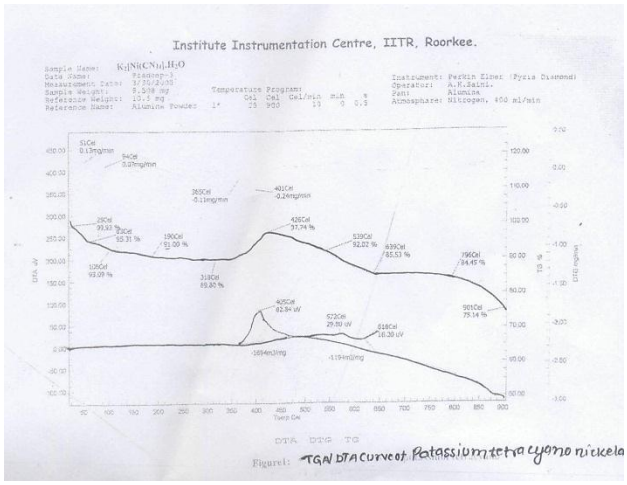

Figure1: TGA DTA Curve of Potassium tetra cyano nickela

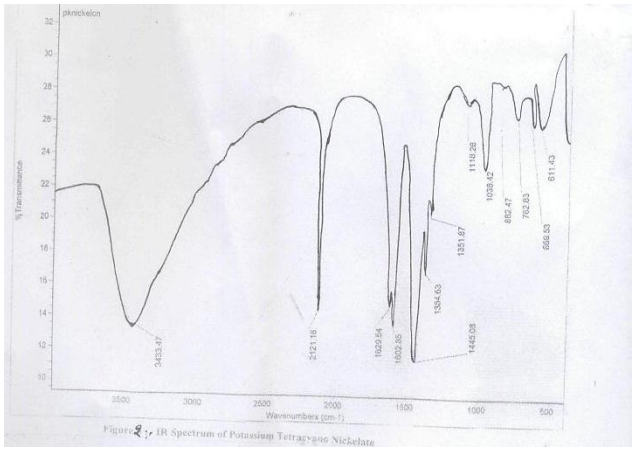

Figure 2 :- IR Spectrum of Potassium Tetracyano Nickelate

Conclusion

Potassium tetracyano nickelate $K_2[Ni(CN)_4]H_2O$ was prepared and their structure was established by TGA/DTA, C, H, N analysis, IR-Studies and XRD techniques. Potassium tetracyano nickel used in biomolecules. Interaction with Nucleotides was very little at 426 ^{0}C $K_2[Ni(CN)_4]H_2O$ compound was stable.

References

[1]. S. M. Ostrovsby, V. Sciltter, and M Araine, Mol. Cryst. Liq. Cryst. Sci Technol 132(2000)1444.

[2]. K. Ming, E. P. Fanmick, and A .W. Richard, American Chemical Society, **136** (2002) 1722.

[3]. G. Novitskii, S. Shova and V. K. Voronkova, and L. Korobchenbo, Russian Chemical Bulletin, **136** (2002) 1721.

[4]. A. R. Fortea, P. Alemany, and P. Alvarez, American Chemical Society, **136** (2002) 1758.

[5]. H. Z. Kou, G. S. Bai and O. Z. Wang, Thermochem. Acta, **136** (2002) 1757.

[6]. S. Kenn, and J. Z. ming, American Chemical Society, **136** (2002) 1757.

[7]. J. E. Koo, O. H. Kim, Y. S. Kim and K. D. Young, Anorganische. And Allgemeine Chemie, 42 (2003) 2983.

[8]. S. Kenneth, J. H. Jarboe and A. Stacy, Inorganic Chemistry, 42 (2003) 3559.

[9]. V. Gopi and T. Onska, J. Electroanal Chem., **131** (1999) 1022.

[10]. S. Ranjan and S. K. Rikshit, Polyhedron Elsevier science Ltd. **130** (1998) 1520.

[11]. B. Onoa, and Morena, Tran. Met. Chem., 23 (1998) 485.

[12]. E. J. Osterberg and J. Hazell, Tepsen Acta Crystalloges, Sect C: **133** (2000) 1310.

[13]. I. M. Isamail, M. R. Sourougy, Jor. Of molecular Str., **131** (1999) 1185.

[14]. M. S. Holmes and G. S. Gregongy, Cryst. Liq. Cryst sci technol sector A **128** (1998)1164.

[15]. A. Steponavicius, B. Radziuniene and E. Ivashbenic, Chomija academica. **126** (1994)1104.

[16]. S. I. Ali, S. Sharma and Z. khan, Transition Met-Chem. **125** (1996) 787.

[17]. C. P. Jefrrery, M. Mcisel and Q, R. Mcisel, Guinesville Florida., 42 (2003) 2842.

[18]. X. Shen, L. B. Zou, X. Zhong and Y. Y. Liu, Inorganic Chemistry, **137** (2002) 1569.

[19]. G. Ponceil, A.T. Von and J.J. Fripeat, Origin of Life, 6 (1975) 401.

[20]. N. Lahva and S. Chang, J. Mol. Evol., 8 (1976) 357.

[21]. Prout, W.E., Russel, E.R. and Groh, H.J., J. Inorg. Nucl. Chem., **27** (1965) 474.

[22]. S. Viladbar, R. Aggarwal, and Kamaluddin, Bull Chem. Soc. Jpn., 69 (1996) 95.

[23]. T. Alam, and Kamlauddin, BullChem. Soc. Jpn, **72** (1999) 1697.

[24]. S. Viladkav, T. Alam, and Kamaluddin, J. Inorg. Biochem., 53 (1994) 69.

[25]. M. T. Beck, Metal ions in Biological system, Marcel Dekker, New Yor,1998, p. 7.

[26]. I.Y. Saramaga, V. Y. Doyge, V.Y. yarovets, and B.I. Chernyok, Ukr. Khim Zn., **64** (1998) 1-2,, C.A. (131 (14), 1920721.

[27]. P. Morys, and G. Gliemann, Anorganische, **313** (1976) 1224. C.A. 85: 169207.

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