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# Synthesis and Characterisation of Iron (II) Chromate Nano Particles

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**ABSTRACT**

Iron (II) Chromate nano particles were synthesized via chemical co precipitation method from Iron (II) chloride and Potassium Chromate. Structural and compositional properties were characterized by XRD, SEM, FTIR and UV spectroscopy X-ray diffraction (XRD) confirmed the preferential growth of Iron (II) Chromate nano particles that width is 61.27nm. The SEM image shows the synthesized Iron (II) Chromate show well crystallized particles with spherical morphology. The FTIR spectrum is used to study the stretching and bending frequencies of molecular functional groups in the sample. From UV spectrum, the band gap of Iron (II) Chromate nano particles is found to be 3.5eV. From AAS studies it is found that the absorbance is directly proportional to the concentration. The linear fit indicates that Iron Chromate nanoparticles have been distributed in proper proportion.



## 1.Introduction

The synthesis of nano materials with uniform particle size is a subject of intensive research in recent times because of the fundamental scientific interest in nanoparticles and because of the interest in nanotechnology. These nano material's exhibit very interesting electrical, optical, magnetic and chemical properties, which cannot be achieved by their bulk counter parts. Nanomaterials may also be used in various technological applications viz. refrigeration systems, medical imaging, drug targeting and other biological applications, and catalysis. [1]

This paper is discussing about easy, simple and low cost preparation i.e. chemical co precipitation of Iron (II) Chromate nanoparticles and its characterizations – XRD, SEM, FTIR, UV and AAS studies.

## 2. Experimental Details

Nano particles of Iron (II) Chromate were prepared by chemical co precipitation method by adding Iron (II) chloride and Potassium Chromate. Precise amounts of reagents taking into account their purity were weighed and dissolved separately in distilled water into 0.1M concentration. After obtaining a homogeneous solution, the reagents were mixed using magnetic stirring. The precipitate was separated from the reaction mixture and washed several times with distilled water and ethanol. The wet precipitate was dried and thoroughly ground using agate mortar to obtain the samples in the form of fine powder.

## 3. Tests conducted

X-ray diffraction is an ideal technique for the determination of crystallite size of the powder samples. The basic principle for such a determination involves precise quantification of the broadening of the peaks. XRD line broadening method of particle size estimation was chosen in this investigation for determining the crystallite size of the powder sample. XRD study of the powder samples was carried out at Centre for Electro Chemical Research Institute, Karaikudi. The morphology of the powder samples was studied by the scanning electron microscope (SEM) analysis taken at STIC Cochin. The infra red spectroscopic (IR) studies of Iron (II) Chromate nano particles were made by using 'SHIMADZU' FTIR 8400S model spectrometer through KBr method. The UV spectrum was taken in the absorbance mode in the wavelength range from 200 to 800 nm

## 4. Results and discussion

### 4.1. XRD studies

#### 4.1.1. XRD – Particle Size Calculation

The XRD patterns of the prepared samples of Iron (II) Chromate nanoparticles are shown in figure.1. XRD studies reveal that the samples are nano sized and crystalline. The fine particle nature of the samples is reflected in the X-ray line broadening. The size of the synthesized Iron (II) Chromate nano particles are calculated using Scherrer equation

$$D = 0.9\lambda/\beta \cos\theta$$

where λ represents wavelength of X rays, β represents half width at full maximum and θ is the diffraction angle.

2Theta = 28.5282; β = 0.1338 x 3.14 / 180 = 0.002334; D = (0.9 * 0.154) / (0.002334) * cos (14.2641) = 61.27nm.

The average grain size of the particles is found to be 61.27nm. [2]

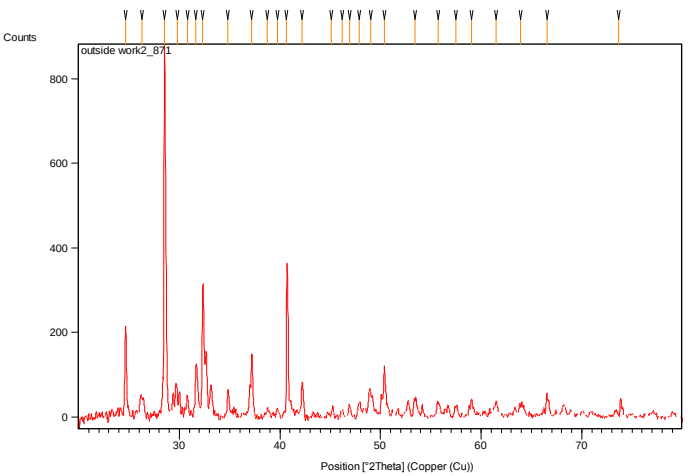


**Figure.1 XRD pattern of Iron (II) Chromate Nano particles**

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### 4.2. SEM studies

Scanning electron microscopy was used to analyze the morphology and size of the synthesized Iron (II) Chromate nano particles. Figure.2, figure.3, and figure.4 show the SEM images of the Iron (II) Chromate nano-particles at various magnifications. The SEM images of Iron (II) Chromate nano particles show well crystallized particles with spherical morphology. In this case the particles sizes are slightly increased and is also observed that the particles are distributed with agglomeration.

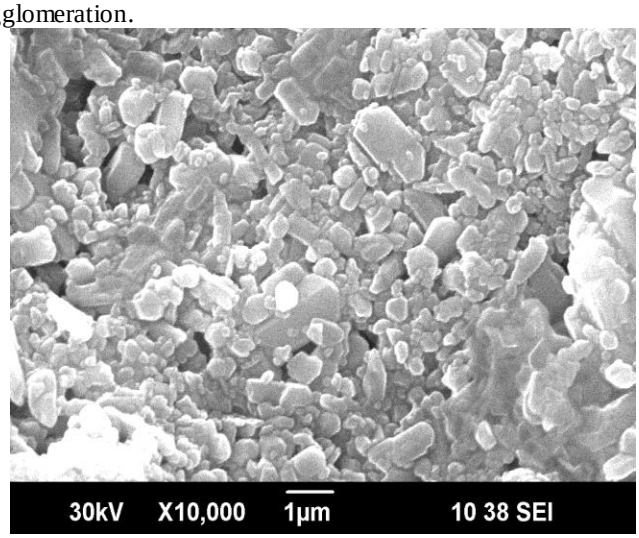


**Figure.2 SEM image at 10000 magnifications.**

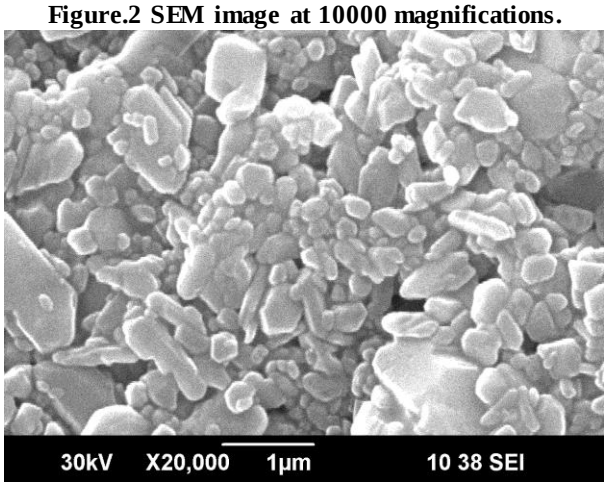


**Figure.3 SEM image at 20000 magnifications.**

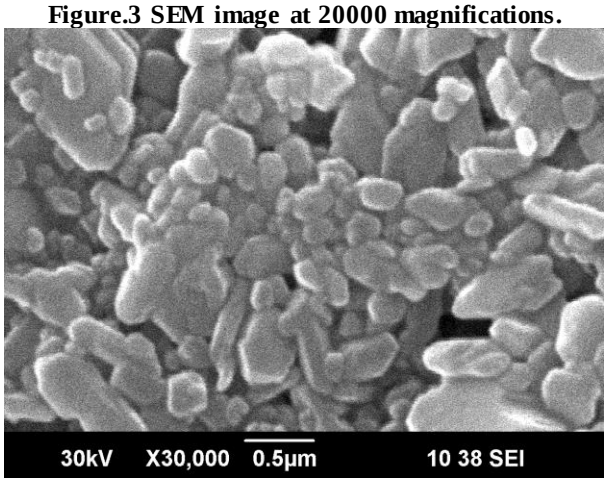


**Figure.4 SEM image at 30000 magnifications.**

### 4.3. FTIR Studies

The FTIR spectrum of the Iron (II) Chromate sample is shown in the figure.5.The FTIR spectrum for Iron Chromate shows a strong peak at 3355.91cm$^{-1}$ corresponding to the free O-H group. Another peak with a maximum of 1587.31cm-1 is due to the bending mode of the hydroxyl group of water. The spectrum also shows peak at 1400.22cm-1 indicating $CH_2$ bending and the peak at 495.67cm-1 indicates Fe-O vibrations. [3]

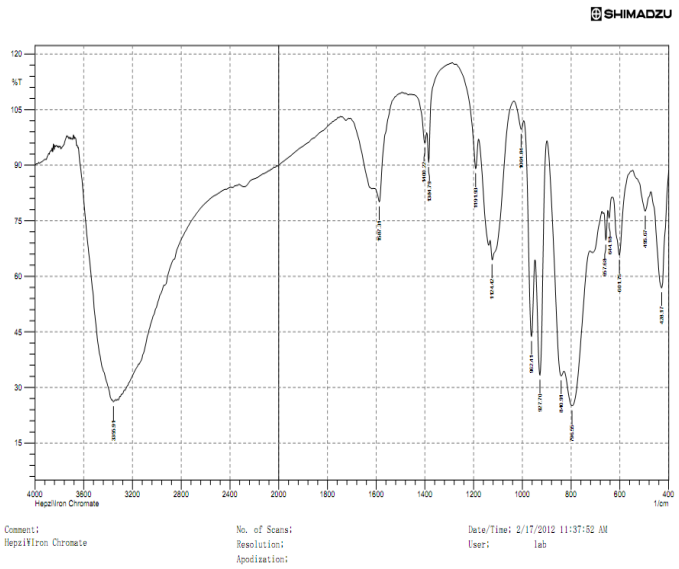


**Figure.5 FTIR spectra of Iron (II) Chromate Nano particles**

### 4.4. UV Studies

The band gap of the prepared sample Iron (II) Chromate nano particles was determined by using UV visible studies. From the UV spectrum the optical band gap of Iron (II) Chromate nano particles is 3.5eV. Figure.6 shows the graph to find the band gap of Iron (II) Chromate nano particles.

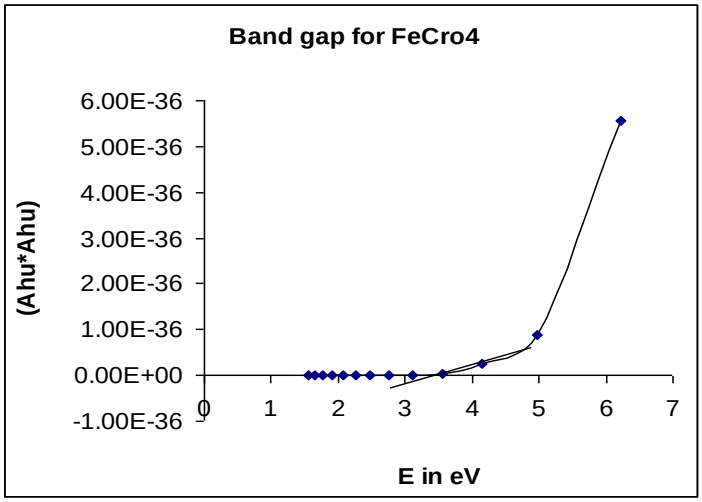


**Figure.6 Graph to find the band gap of Iron (II) Chromate Nano particles.**

### 4.5. AAS Studies

The synthesized Iron (II) Chromate nanoparticles have been analyzed by AAS with optical parameter settings Fe wavelength 248.3nm and Air – $C_2H_2$ flame type. The results are given in table-1. A calibration curve diagram for Concentration of Iron (II) Chromate nanoparticles in parts per million (ppm) Vs Absorbance has been drawn and a linear fit has been got. It is observed from the figure.7 that the absorbance is directly proportional to the concentration. The linear fit indicates that Iron (II) Chromate nanoparticles have been distributed in proper proportion. [4]

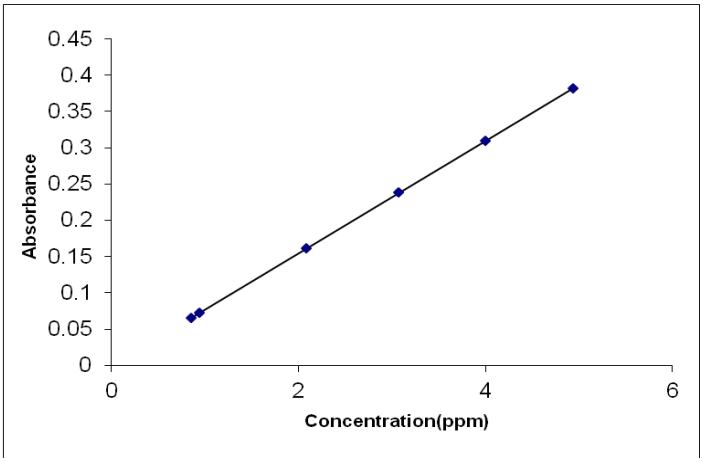


**Figure. 7 Concentration Vs Absorbance.**

**Table-1 AAS Analysis Result**

| True value | Standard | Sample | %R | Actual Concentration % | Concentration (ppm) | Absorbance |
|---|---|---|---|---|---|---|
| 1.0000 | 0.9368 | 0.0726 | 94 | 16.2281 | 0.8491 | 0.0658 |
| 2.0000 | 2.0839 | 0.1615 | 104 | | | |
| 3.0000 | 3.0749 | 0.2383 | 102.3 | Weight Factor = 1.000000<br>Volume Factor = 1.00<br>Dilution Factor = 1.00<br>Correction Factor = 1.000000 | | |
| 4.0000 | 4.0014 | 0.3101 | 100 | | | |
| 5.0000 | 4.9330 | 0.3823 | 98.63 | | | |

## 5. Conclusions

The Iron (II) Chromate nano particles have been prepared by chemical co-precipitation method. XRD analysis suggests that the average particle size is in the nano range (61.27nm). The SEM picture reveals the well crystallized particles with spherical morphology. From the FTIR spectrum, the stretching and bending frequencies of the molecular functional groups in the sample are studied. From the UV spectra, the band gap was found. From AAS studies it is found that the absorbance is directly proportional to the concentration. The linear fit indicates that Iron Chromate nanoparticles have been distributed in proper proportion.

## 6. References

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