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Research Paper

A Study of Some Optical Properties of Chromic Chloride($CrCl_3$)Thin Film

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ABSTRACT: *In this work,the optical properties of chromic chloride(*$CrCl_3$ *)thin film prepared at different thickness has been measured. The relationship between transparency, absorbance and photon energy for the prepared samples has been studied. It has been found, the behavior of curves is the same for each samples.Moreover, it has been observed that*The best fit of theexperimental curve to a band gap function was obtained for n = 2 to direct bandgap energy values the obtained values are 1.531 eV, 1.533 eV,1.536 eV, and 1.539 eV for dip the rated of Cl (0.0 - 0.25 – 0.50 and 0.75) respectively.

Keywords:*Film thickness, Energy band gap,(*$CrCl_3$ *) , Optical Properties.*

I. INTRODUCTION

The physical properties plays important role in material science, it has been able to interpret many of the phenomena related to materials, The changes in the physical properties of a system can be used to describe its transformations or evolutions between its momentary states [1] Physical properties include appearance, texture, color, odor, melting point, boiling point, density, solubility, polarity, and many others [2]. In this work we study the Absorption coefficient derived from ($CrCl_3$)thin film with different thickness and Transmission spectra for ($CrCl_3$)samples with different thin film thickness to describe the optical properties for($CrCl_3$), many devices are used to study the optical properties of materials, but the problem is how to choose effective devices for measurement of these properties. The optical measurements comprise measuring the absorbance and transmittancewith range (350 - 900 nm), in the current study, by using (UV mini 1240 spectrophotometer.

II. CHROMIC CHLORIDE($CrCl_3$) STRUCTURE AND APPLICATIONS

Anhydrous chromium (III) chloride agrees the YCl3 structure, with $Cr3+$ occupying two thirds of the octahedral interstices in alternating layers of a pseudo-cubic close packed lattice of $Cl-$ ions. The absence of cations in alternate layers leads to weak bonding between adjacent layers. For this reason, crystals of CrCl3 cleave easily along the planes between layers, which results in the flaky (micaceous) appearance of samples of chromium (III) chloride.[3][4], Chromium(III) chloride is used as the precursor to many organ chromium compounds, for example chromium, Phosphine complexes derived from CrCl3 catalyze the dimerization of ethylene to 1-hexene.[5][6], One niche use of CrCl3 in organic synthesis is for the in situ preparation of chromium(II) chloride, a reagent for the reduction of alkyl halides and for the synthesis of (E)-alkenyl halides. The reaction is usually performed using two moles of CrCl3 per mole of lithium aluminum hydride, although if aqueous acidic conditions are appropriate zinc and hydrochloric acid may be sufficient, Chromium(III) chloride also used as a Lewis acid in organic reactions, for example to catalyze the nitroso Diels-Alder reaction.[7]

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Fig (1) shows the relation between absorbance and photon energy

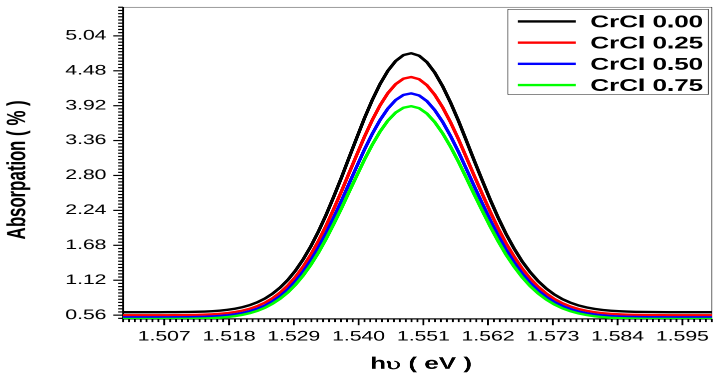

Fig (2) shows the relation between transparent and photon energy

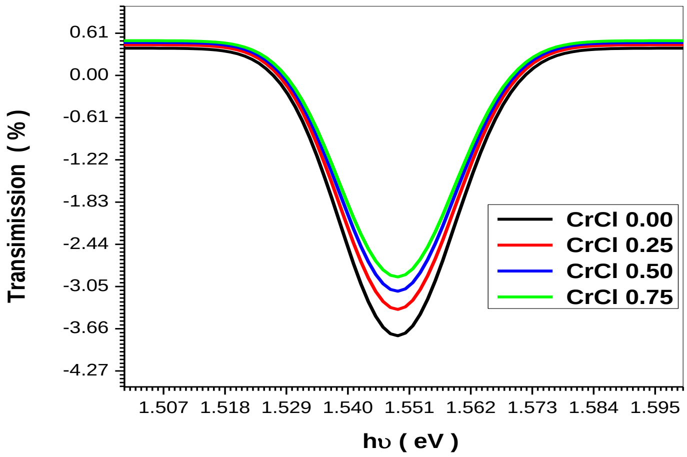

Fig (3) shows the relation between reflection and photon energy

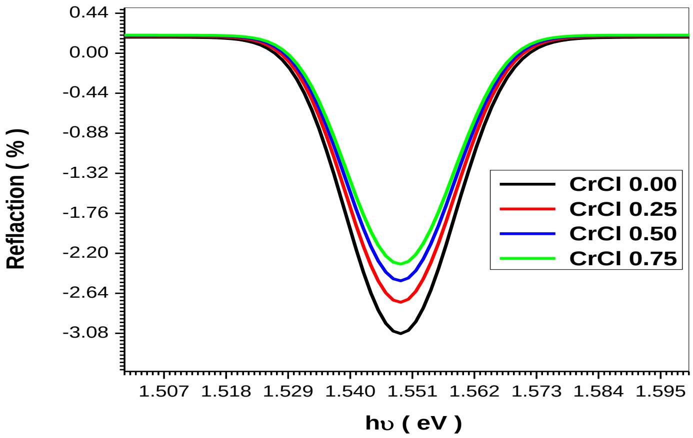

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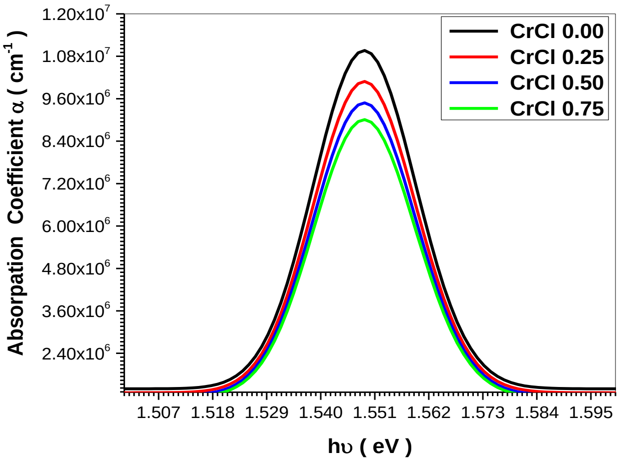
Fig (4) show the relation between absorption coefficient and photon energy



(5) show the relation between extinction coefficient and photon energy

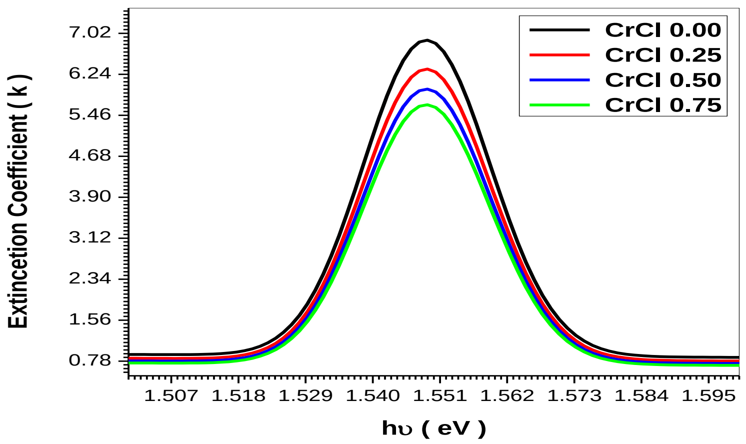
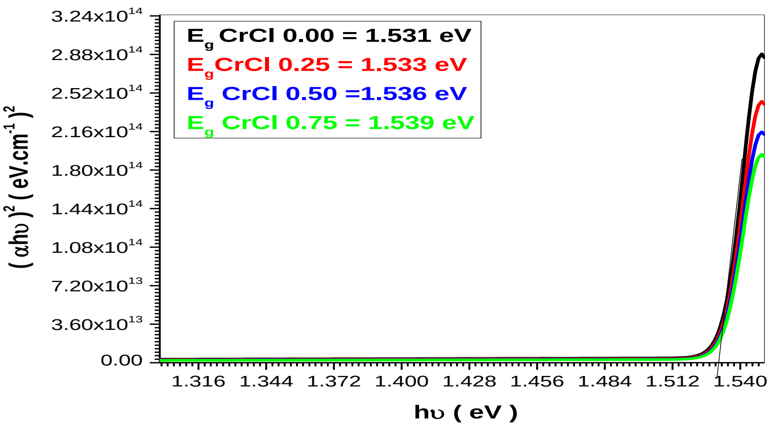


Fig (6) the optical energy gap (Eg) value of Cr Cl



III. RESULTS AND DISSECTIONS

Fig (1) shows the relation between absorbance and photon energy, we found the behavior of curves is the same for each curves. The rapid increase of an absorption in the low energy and sudden increase in special energy, this is refer to electronic transition, and this increase is continuous with the increase of photon energy, absorbance value increased with rated of Cl increase.

Fig (2) shows the relation between transparent and photon energy, we had been found rapid decrease in low energies and sudden decrease in special energies and it continuous with decrease in high energy, rated of Clincrease refers to the decrease in transparent value.

The reflection were calculated depended energy safe law using the relation

R + T+ A = 1 ………………………………. (1)

When: R- Reflection, T- TransmitionFig (3) shows the relation between reflection and photon energy. we had been found rapidly increase in reflection value .until to arrive to peak, then it reduce from high energy because of less absorption in low energies from energy gap Transmition decreasing due to reflection increasing using the relation (1) .At high energies from energy gap, the a absorbance is increasing, this cause the reduce in reflection, and the upper corresponding energy gap value (1.55-1.6)eV. Increasing threated of Cl due to minor change in to peak curves, it is shifted low energies.

The absorption coefficient α was calculated using

$$\alpha = \frac{2.303\,xA}{L} \quad (2)$$

Where α is absorption coefficient L optical axes length on the sample

Fig (4) shows the plot of absorption coefficient as a function of photon energy. It could be seen from the graphthat $Cr\ Cl$ had maximum absorptions between 1.54 and1.56 eV

In depended on conclusion absorption value in relation (1), extinction coefficient was measured by using relation

$$k = \frac{\alpha\lambda}{4\pi} (3)$$

Were K is Extinctioncoefficient,λ is Wave length

And the fig (5) show the relation between extinction coefficient and photon energy. It was found that the decreasing at extinction coefficient value with increase the rated of Cl because of decreasing absorption coefficient value with increase of the rated of Cl like relation (2)

The optical energy gab was calculated using the well-knownTauc's relation:

$$\alpha \ = \ A\,(hv - Eg)\ nh\bar{v}(4)$$

Where$A$ is a constant, hv is the photon energy, and α isthe absorption coefficient, while n depends on the nature ofthe transition. For direct transitions n = 1/2 or 2/3, whilefor indirect ones n = 2 or 3, depending on whether theyare allowed or forbidden, respectively. The best fit of theexperimental curve to a band gap function was obtained for n = 2 to direct bandgap energy values the obtained values are 1.531 eV, 1.533 eV,1.536 eV, and 1.539 eV for dip the rated of Cl (0.0 - 0.25 – 0.50 and 0.75) respectively Fig (6). There is a slight increasein band gap as the dip times increases.

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