Sudan University of Science and Technology

College of Graduate Studies

Change on Optical Properties Due to Change in Thickness of Mica Film

التغيرفي الخواص الضوئيه نتيجة للتغير في سمك شرائح المايكا الرقيقة

A dissertation Submitted for Partial Fulfillment of the Requirements for the Degree of Master of Science in Physic.

By:

Razan Almuzamil Mohamed Alkhalifa

Supervisor:
Dr. Abdelnabi Ali Elamin Ali

(2018)

بسم الله الرحمن الرحيم

قال الله تعالى:

(وَاذْكُرُواْ إِذْ جَعَلَكُمْ خُلَفَاءَ مِن بَعْدِ عَادٍ وَبَوَّأَكُمْ فِي الأَرْضِ تَتَّخِذُونَ مِن سُهُولِهَا قُصُوراً وَتَنْحِتُونَ الْجِبَالَ بُيُوتاً فَاذْكُرُواْ آلاَءَ اللّهِ وَلاَ تَعْثَوْا فِي الأَرْضِ مُفْسِدِينَ).

سورة الأعراف ـالأيه:74

صدق الله العظيم

أ

Dedication

From the depth of my heart I dedicate this work to my lovely father, to my dear mother, to my little brothers, to my cute sisters, To my friends whom I have shared unforgettable time with them And to all people I love. To my great supervisor I also dedicate this work to everyone who taught me in this university.

Acknowledgment

This research project would not have been possible without the support of many people. I would like to express my very great appreciation and deep gratitude to my supervisor Dr. Abdelnabi Ali Elamin For here patient guidance and valuable suggestions during the planning and development of this research work. His willingness to give his time so generously has been very much appreciated .

My grateful thanks are also extended to Dr.Abd Alsakhi Suliman for the statistical

 analysis of my study results. Also special thanks to Mr. Mohamed abalaziz.

Abstract

Mica group of sheet <u>silicate</u> (<u>phyllosilicate</u>) <u>minerals</u> includes several closely related materials having nearly perfect <u>basal cleavage</u>. All are <u>monoclinic</u>, with a tendency towards pseudohexagonal <u>crystals</u>, and are similar in chemical composition. The nearly perfect cleavage, which is the most prominent characteristic of mica, is explained by the <u>hexagonal</u> sheet-like arrangement of its <u>atoms</u>.

This research deals with the applications of spectroscopy, which is the detection of some elements of the mica .

Mica was used in several fields, including electrification, electronic and cosmetic, and in houses for decoration .the optical properties of two samples of mica were studied with a slight difference in thickness, namely absorbance, Absorption coefficient , reflectivity ,and transitivity , and there was a match in number of properties and slight differences in absorption properties, of the two samples with the recommendation to conduct more research and knowledge of many properties, including electrical properties such as conductivity whether it can be and converted to a substance of superconducting material using certain chemical ways .

المستخلص

مجموعة المايكا من سليكات الألواح المعدنيه (السيليكات) تحتوي علي العديد من المواد المرتبطه ارتباطا وثيقا مع وجود انقسام قاعدي تماما تقريبا كلها احادية الميل مع ميل نحو بلورات كاذبه وهي متشابهه في التركيب الكيميائي يفسر الانقسام التام تقريبا والذي يعتبر ابرز سمات المايكا بالترتيب الشبيه بالرقاقه السداسية لذراته .

تناول هذا البحث احدي تطبيقات علم الأطياف وهي الكشف عن بعض العناصر المكونه للمايكا وتراكيز هذه العناصر بتقنية فلورة الأشعه السينيه .

تستخدم المايكا في عدة مجالات منها الكهربيه والالكترونيه والتجميليه وفي المنازل بغرض الزينه تمت دراسة الخواص الضوئيه لعينتين من المايكا مع اختلاف طفيف في السمك الا وهي الامتصاصيه ومعامل الامتصاص والانعكاسية والانتقاليه وقد وجد تطابق في عدة خواص واختلاف طفيف في خاصية الامتصاص يعزي الي الاختلاف في سمك كل من العينتين مع التوصيه علي اجراء المزيد من الابحاث ومعرفة العديد من الخواص بما في ذلك الخواص الكهربيه ومدي امكانية تحويلها الي ماده فائقة التوصيل بطرق كيميائيه معينه.

Table of contents

26	4.2 Results	22
27	4.3 Discussion	27
28	4.4 Conclusion	28
29	4.5 Recommendations	28
30	4.6 References	29

List Of Table

Table	*No.page*
4.1 The elements and their concentration	22

List of Figure

Chapter One

Introduction

1.1 Preface

Mica group of sheet <u>silicate</u> (<u>phyllosilicate</u>) <u>minerals</u> includes several closely related materials having nearly perfect <u>basal cleavage</u>. All are <u>monoclinic</u>, with a tendency towards pseudohexagonal <u>crystals</u>, and are similar in chemical composition. The nearly perfect cleavage, which is the most prominent characteristic of mica, is explained by the <u>hexagonal</u> sheet-like arrangement of its <u>atoms</u>.

The word mica is derived from the <u>Latin</u> word <u>mica</u>, meaning a crumb, and probably influenced by <u>micare</u>, to glitter[1].

Human use of mica dates back to prehistoric times. Mica was known to ancient Indian, Egyptian, Greek and Roman and Chinese civilizations, as well as the Aztec civilization of the New World.

The earliest use of mica has been found in cave paintings created during the Upper Paleolithic period (40,000 BC to 10,000 BC). The first hues were red (iron oxide, hematite, or red ochre) and black (manganese dioxide, pyrolusite), though black from juniper or pine carbons has also been discovered. White from kaolin or mica was used occasionally.

A few kilometers northeast of Mexico City stands the ancient site of Teotihuacan. The most striking structure of Teotihuacan is the towering Pyramidof the Sun. The pyramid contained considerable amounts of mica in layers up to 30 cm (12 in) thick [2].

Natural mica was and still is used by the Taos and Picuris Pueblos Indians in north-central New Mexico to make pottery. The pottery is made from weathered Precambrian mica schist, and has flecks of mica throughout the vessels. TewaPueblo pottery is made by coating the clay with mica to provide a dense, glittery micaceous finish over the entire object[3].

Mica flakes (called abrak in Urdu and written as ابرک) are also used in Pakistan to embellish women's summer clothes, especially dupattas (long light-weight scarves, often colorful and matching the dress) [4].

muscovite and phlogopite, which are used in a variety of applications. Mica's value is based on several of its unique physical properties. The crystalline structure of mica forms layers that can be split or delaminated into thin sheets usually causing foliation in rocks. These sheets are chemically inert, dielectric, elastic, flexible, hydrophilic, insulating, lightweight, platy, reflective, refractive, resilient, and range in opacity from transparent to opaque. Mica is stable when exposed to electricity, light, moisture, and extreme temperatures. It has superior electrical properties as an insulator and as a dielectric, and can support an electrostatic field while dissipating minimal energy in the form of heat; it can be split very thin (0.025 to 0.125 millimeters or thinner) while maintaining its electrical properties, has a high dielectric breakdown, is thermally stable to 500 °C (932 °F), and is resistant to corona discharge. Muscovite, the principal mica used by the electrical industry, is used in capacitors that are ideal for high frequency and radio frequency. Phlogopite mica remains stable at higher temperatures (to 900 °C (1,650 °F)) and is used in applications in which a combination of high-heat stability and electrical properties is required. Muscovite and phlogopite The mica group represents 37 phyllosilicate minerals that have a layered or platy texture. The commercially important micas are are used in sheet and ground forms [5].

Sheet mica is used principally in the electronic and electrical industries. Its usefulness in these applications is derived from its unique electrical and thermal properties and its mechanical properties, which allow it to be cut, punched, stamped, and machined to close tolerances. Specifically, mica is unusual in that it is a good electrical insulator at the same time as being a good thermal conductor. The leading use of block mica is as an electrical insulator in electronic equipment. High-quality block mica is processed to line the gauge glasses of high-pressure steam boilers because of its flexibility, transparency, and resistance to heat and chemical attack. Only high-quality muscovite film mica, which is variously called India ruby mica or ruby muscovite mica, is used as a dielectric in capacitors. The highest quality mica film is used to manufacture capacitors for calibration standards. The next lower grade is used in transmittingcapacitors. Receiving capacitors use a slightly lower grade of high-quality muscovite.

Mica sheets are used to provide structure for heating wire (such as in Kanthal or Nichrome) in heating elements and can withstand up to 900 °C (1,650 °F)[6].

1.2 The Objective of Thesis

The objective of thesis is:-

(i)   Detection of the elements in the mica.

(ii)   determine the optical properties of mica.

1.3Thesis problem

There are several problems with Mica. Currently the main problems faced by mica type of materials. In general is lack of potential in the field of study of applied science researchers. In addition to scarcity of samples and difficulty in obtaining.

1.4Thesis Layout

This thesis is consist of four chapters, chapter one introduction and literature review, chapter two basic concepts of mica and its applications, chapter three Experimental Work(materials, device and method), chapter four results and discussion and recommendations, finally the list of references.

1.5Literature Review

The first study entitled"some physical properties of mica" was conducted in 1945 by Peter Hindnert and George Dickson they have found that the linear thermal expansion ,changes in structure ,power factors ,and effects of heat treatment on the thickness ,opacity ,and color of mica(muscovite,phlogopite ,biotite, ripidolite ,and zinnwaldite)from different domestic and foreign sources .tremendous linear thermal expansion was noted for some samples of phlogopite and biotite micas in direction perpendicular to the cleavage plane. The transitions shown in the expansion curves of these samples at elevated temperatures appear to related to the structural changes indicated in the X-ray diffraction patterns .heat treatment of

two phlogopite micas and two muscovite micas to 60000c, with or without a load caused considerable increases in the power factors of the former and only slight changes in the latter. Nearly all the muscovite samples showed the greatest increases in thickness(up to 155 percent)after heat treatment at 8000c .the large increases in thickness of nearly all the muscovite samples accompanied changes from clear or translucent of opaque ,or from polychrome to metallic color. None of the species of mica can be considered as a substance or material of fixed and reproducible properties .the physical properties of mica depend largely upon the chemical composition , the nature of the crystals, their magnitude and orientation, the presence of impurities, the way in which these enter the structure ,the heat treatment, etc. some of the phlogpite and biotite micas that possess tremendously high thermal expansion in a direction perpendicular to the cleavage plane may be used for high-expanding elements in temperature-responsive devices but may be unsatisfactory for use in devices in which large changes in dimensions with changes in temperature are not desirable

Peter Hindnert and George Dickson are give the data on the linear thermal expansion, changes in structme, power factors, and effects of heat treatments on thickness,opacity, and color of micas (muscovite, phlogopite, biotite, ripidolite,andzinnwaldite)from different domestic and foreign sources.The results obtained on the thermal expansion of 30 samples ofmicas in a direction perpendicular to the cleavage plane when subjected to a load over the range 200 to 6000 C (or 7000 C). Tremendous expansion was noted forsome of the samples of phlogopite and biotite micas. The maximumcoefficients of expansion of the samples of phlogopite and biotite micas6000 C) per degree centigrade, respectively. The coefficients of expansionof the samples ofmuscovite, ripidolite, and zinnwaldite micasare comparatively low. The maJ...wum coefficient of expansion of thesamples of these three types of mica is 0.000036 per degree

centigrade.Laue X-ray diffraction patterns of a few samples of micas (muscovite,phlogopite, and biotite), at room temperature and at elevatedtemperatures. The transitions shownin the expansion curves of two phlogopite samples and a biotite sampleat elevated temperatures appear to be related to the structural changes. Thesechanges may be ascribed to the buckling of very thin layers duringheating, resulting in the displacement or tilting of the elementaryare 0.0552 (between 1000 and 1140 C) and 0.00411 (between 5000 6000 C) per degree centigrade, respectively. The coefficients of expansion of the samples of muscovite, ripidolite, and zinnwaldite micasare comparatively low. The maJ...wum coefficient of expansion of the samples of these three types of mica is 0.000036 per degree centigrade .Laue X-ray diffraction patterns of a few samples of micas(muscovite, phlogopite, and biotite), at room temperature and at elevated temperatures. The transitions shown in the expansion curves of two phlogopite samples and a biotite sample at elevated temperatures appear to be related to the structural changes . These changes may be ascribed to the buckling of very thin layers during heating, resulting in the displacement or tilting of the elementary and crystals of the mica laminas. The power factors of two samples of phlogopite mica from Madagasca rand Mozambique were found to be considerably greater at 100 kc/sthan at 1,000 kc/s. The power factors of these samples are considered ably larger than the power factors of two samples of muscovite mica from Brazil and Guatemala. Heat treatment of the samples of phlogopite and muscovite micas to 6000 C with or without a load , caused considerable increases in the power factors of the former and only slight changes in the latter.

Nearly all of the muscovite samples showed the greatest increases in thickness (up to 155 percent) after heat treatment at 8000 C. The results on the changes in thickness of the phlogopite and muscovite samples indicate that the former resist

elevated temperatures better than the latter. The large increases in thickness of nearly all of the muscovite samples accompanied changes from clear or translucent to opaque, or from polychrome to metallic color. N one of the species of mica can be considered as a substance or material of fixed and reproducible properties. There are wide variations in such properties as thermal expansion, power factor, and color. These properties of mica depend largely upon the chemical composition, the nature of the crystals, their magnitude and their orientation, the presence of impurities, the way in which these enter the structure, the heat treatment, etc. Some of the phlogopite and biotite micas, which possess tremendously high thermal expansion in a direction perpendicular to the cleavage plane, may have decided advantages when used for high expanding elements in temperature responsive device. In this research to determine the optical properties of mica[7].

Chapter Two
Theoretical Background

2*.1Introduction*

It is any of a group of hydrous aluminosilicate minerals with the general formula $(K,Na,Ca)(Mg,Fe,Li,Al)_23(Al,Si)_4O_{10}(OH,F)_2$ that can be split easily into thin, partly transparent sheets. The word mica is derived from the Latin word mica, meaning a crumb, and probably influenced by micare, to glitter. Mica is common in igneous and metamorphic rocks and often occurs as flakes or sheets. It is highly resistant to heat and is used in electric fuses and other electrical equipment. Mica forms flat six-sided monoclinic crystals along with an extraordinary split in the direction of larger surfaces. This allows the mineral to be easily cleaved into optically flat films. High in silica, this stone has the extensive capacity to remain elastic and tough even at high temperatures. It is found having thin-sheet like or plate-like structure with various composition and physical properties. This helps the people to handle and work with the stone in those places with high and humid temperatures.

2.2 Types of Mica

Mica is the name given to a group of silicate minerals that have silicon and oxygen as their two major components. The Mica family of minerals includes several variations based on chemical composition and characteristics [7].

Fig.1.1 The Biotite-Muscovite –boromuscovite.

2.3 Uses of Mica

Mica was used in many field of application :

It is used in paints as a pigment extender and also helps to brighten the tone of colored pigments.

It is a superior insulator. So in the electrical industry it is used as thermal insulation and in electronic equipment as electrical insulators.

Its shiny and glittery appearance makes it ultimate for toothpaste and cosmetics.

It is invariably used for fillers, extenders along with providing smoother uniformity, improving workability and prevents cracking.

It can be used as an insulator in home attics, concrete blocks and also poured into open top walls.

It can also be added to grease to increase its durability and giving it a better surface.

It can also be used as a soil conditioner particularly in potting soil mixes and in gardening plots [8].

2.4 Properties of mica

Mica belongs to a very important and rather large group of minerals that are highly suitable for several applications. However, its advanced properties make it highly suitable for use in various places.

Field of science

In physical field mica is translucent, easily split into thin films along its cleavage, optically flat, colorless in thin sheets, elastic and incompressible.

While in chemical field It is a compound hydrous silicate of aluminum, which also contains iron, magnesium, potassium, sodium fluorine, lithium and also few traces of numerous other elements. It is constant and entirely static to the action of water, acids (except for hydrofluoric and concentrated Sulphur), alkalis, conventional solvents, bases, and oil. It remains almost unchanged by atmospheric action.

And in electrical field mica has the exclusive combination of uniform dielectric steadiness, capacitance stability, enormous dielectric power, high Q factor and lower power loss, high electrical resistance and low temperature coefficient. It is highly regarded for its resistances to arc and corona discharge without causing any lasting injury.

And in thermal field It is highly fire proof, incombustible, non- flammable, infusible, and also can resist temperatures of up to 1000 degrees Celsius/1832 degrees Fahrenheit. However this depends on the type and variety of Mica used. It has excellent thermal stability, lower heat conductivity, and can be easily exposed to high temperatures without visible effect.

In mechanical mica is highly tough, having high tensile strength, elastic, and along with being flexible. It has immense compression power and can be machined, die-punched, or hand cut [9].

2.2.4 Classification of mica

Mica is a metamorphic mineral. The many variations come from the diverse ways it formed. Mica formations are associated with volcanoes and hydrothermal vents.

2.2.5Characteristics

The most easily recognizable characteristic are the thin crystal layers. With many types of mica the sheets peel off in thin transparent layers due to mica's perfect cleavage. The crystal structure is monoclinic with a somewhat hexagonal crystal shape. These two characteristics are due to the structure of the atoms that make up the mica group. Mica also has a brilliant shininess that glitters and sparkles. In fact the name mica is believed to have come from the Latin word micare which means "to shine." Mica is responsible for the flashes of light in composite rocks such as granite, gneiss, and slate [10].

2.3Thin film

A thin film is a layer of material ranging from fractions of a nanometer (monolayer) to several micrometers in thickness. The controlled synthesis of materials as thin films (a process referred to as deposition) is a fundamental step in many applications. A familiar example is the household mirror, which typically has a thin metal coating on the back of a sheet of glass to form a reflective interface. The process of silvering was once commonly used to produce mirrors, while more recently the metal layer is deposited using techniques such as sputtering. Advances in thin film deposition techniques during the 20th century have enabled a wide range of technological breakthroughs in areas such as magnetic recording media, electronicsemiconductor devices, LEDs, optical coatings (such as antireflective coatings), hard coatings on cutting tools, and for both energy generation (e.g. thin-filmsolar cells) and storage (thin-film batteries). It is also being applied to pharmaceuticals, via thin-film drug delivery. A stack of thin films is called a multilayer. In addition to their applied interest, thin films play an important role in the development and study of materials with new and unique properties. Examples include multiferroic materials, and super lattices that allow the study of quantum confinement by creating two-dimensional electron states [11].

2.4 Optical Properties Of Mica

Optical property of a material is defined as its interaction with electro-magnetic radiation in the visible .Interaction of photons with the electronic or crystal structure of a material leads to a number of phenomena. The photons may give their energy to the material (absorption); photons give their energy, but photons of identical energy are immediately emitted by the material (reflection); photons may not interact with the material structure (transmission); or during transmission photons are changes in velocity (refraction).At any instance of light interaction with a material, the total intensity of the incident light striking a surface is equal to sum of the absorbed, reflected, and transmitted intensities. Thus all six optical phenomena are important such as,[12]

2.4.1 Absorption

The intensity of the net absorbed radiation is dependent on the character of the medium as well as the path length within. The intensity of transmitted or non-absorbed radiation continuously decreases with distance x that the light traverses:

$$I_T = I_o e^{-\beta x} \tag{2.1}$$

Where I is the intensity of the non-reflected incident radiation and ß the absorption Coefficient (in mm^{-1}), is characteristic of the particular material; furthermore, varies with wavelength of the incident radiation. The distance parameter x is measured from the incident surface into the material. Materials that have large values are considered highly absorptive.

2.4.2 Reflection

When light radiation passes from one medium into another having a different index of refraction, some of the light is scattered at the interface between the two media even if

both are transparent. The reflectivity R represents the fraction of the incident light that is reflected at the interface, or

$$R = \frac{I_R}{I_o} \qquad (2\text{-}2)$$

Where I_0 and IR are the intensities of the incident and reflected beams, respectively. If the light is normal (or perpendicular) to the interface, then

$$R = \left(\frac{n_2 - n_1}{n_2 + n_1}\right)^2 \qquad (2\text{-}3)$$

Where $n1$ and $n2$ are the indices of refraction of the two media. If the incident light is not normal to the interface, R will depend on the angle of incidence. When light is transmitted from a vacuum or air into a solid s, then

$$R = \left(\frac{n_s - 1}{n_s + 1}\right)^2 \qquad (2\text{-}4)$$

2.4.3 Absorption coefficients

Much of the information about the properties of materials is obtained when they interact with electromagnetic radiation. When a beam of light (photons) is incident on a material, the intensity is expressed by the Lambert-Beer-Bouguer law:

$$I = I_O EXP^{-\alpha d} \qquad (2\text{-}5)$$

If this condition for absorption is met, it appears that the optical intensity of the light wave, (I), is exponentially reduced while traveling through the film. If the power that is coupled into the film is denoted by I_0, gives the transmitted intensity that leaves the film of thickness d.(α) Is called "absorption coefficient". From (1) it follows that:

$$\alpha = -\frac{1}{d} Lin\left(\frac{I}{I_o}\right) \qquad (2\text{-}6)$$

It is clear that α must be a strong function of the energy hv of the photons. For hv $<E$g

(direct), no electron hole pairs can be created, the material is transparent and α is small.

For hv ≥ Eg (direct), absorption should be strong. All mechanisms other than the

fundamental absorption may add complications (e.g. "sub band gap absorption" through

excitons), but usually are not very pronounced.

 Optical transmission measurements were carried out to determine the film thickness, the

wavelength dependence of the refractive index and optical absorption coefficient. The

optical constants were determined from the optical transmission measurements using the

method described by Swanepoel [13].

 The transparent substrate has a thickness several orders of magnitude larger than (*d)* and

has index of refraction (n) and absorption coefficient (α = 0). The index of refraction for

air is taken to be n_0 =1. In the transparent region (α =0) the transmission is determined by

n and *s* through multiple reflections. In the region of weak absorption α is small and the

transmission begins to decrease. In the medium absorption region α is large and the

transmission decreases mainly due to the effect of α. In the region of strong absorption

the transmission decreases drastically due almost exclusively to the influence of α. If the

thickness *d* is uniform, interference effects give rise to the spectrum[14].

2.4.4 Transmission

The phenomena of absorption, reflection, and transmission may be applied to the passage

of light through a transparent solid. For an incident beam of intensity I_0 that impinges on

the front surface of a specimen of thickness *l* and absorption coefficient, the transmitted

intensity at the back face I_T is:

$$I_T = I_o(1-R)^2 e^{-\beta l}$$

<div align="right">(2-7)</div>

Where R is the reflectance; for this expression, it is assumed that the same medium exists outside both front and back faces. The derivation of Equation (2.4) is left as a homework problem. Thus, the fraction of incident light that is transmitted through a transparent material depends on the losses that are incurred by absorption and reflection. Again, the sum of the reflectivity R, absorptivity A, and transmissivity T, is unity according to Equation (2.2). Also, each of the variables R, A, and T depends on light wavelength. This is demonstrated the transmission[15].

Chapter Three

Experimental Work

3.1 Introduction

This chapter presents the materials and apparatus and method used in this work.

3.2 Materials

The Two samples of mica were collected from the Abu hammed area with different thicknesses (sample 1(10mm)) (sample 2(22mm)), as shown in fig 3.1

Fig 3.1.Two samples of mica

3.3 Apparatus

3.3.1X-ray Fluorescence

X-Ray Fluorescence is defined as "The emission of characteristic "secondary" (or fluorescent) X-rays from a material that has been excited by bombarding with high-energy X-rays or gamma rays. The phenomenon is widely used for elemental analysis [16].When high energy photons (x-rays or gamma-rays) are absorbed by atoms, inner shell electrons are ejected from the atom, becoming "photoelectrons". This leaves the atom in an excited state, with a vacancy in the inner shell. Outer shell electrons then fall into the vacancy, emitting photons with energy equal to the energy difference between the two states. Since each element has a unique set of energy levels, each element emits a pattern of X-rays characteristic of the element [16].The intensity of the X-rays increases with the concentration of the corresponding element. The same underlying physics produces the optical emission spectra which are often observed in high school or college labs and used in quantitative analysis. The inner shells of heavier elements involve higher binding energies so produce photons in the X-ray wavelength range [16].

XRF analysis is a powerful analytical tool for the petrochemical determination of almost all the elements present in a sample. XRF radiation is induced when photons of sufficiently high energy, emitted from an X-ray source, impinge on a material. These primary X-rays undergo interaction processes with the analyze atoms. High-energy photons induce ionization of inner shell electrons by the photoelectric effect and thus electron vacancies in inner shells (K, L, M ...) are created. The prompt transition of outer shell electrons into these vacancies within some 100 fs can cause the emission of characteristic fluorescence radiation. Not all transitions from outer shells or sub shells are allowed, only those obeying the selection rules for electric dipole radiation. The creation of a vacancy in a particular shell results in a cascade of electron transitions, all correlated

with the emission of photons with a well-defined energy corresponding to the difference in energy between the atomic shells involved [11].The family of characteristic X-rays from each element including all transitions allows the identification of the element. Next to this radioactive form of relaxation, a competing process can take place: the emission of Auger electrons. Both processes have Z-dependent probabilities that are complementary: the Auger yield is high for light elements and the fluorescence yield is high for heavy elements [16].

The working principle of XRF analysis is the measurement of wavelength or energy and intensity of the characteristic X-ray photons emitted from the sample. This allows the identification of the elements present in the analyze and the determination of their mass or concentration. All the information for the analysis is stored in the measured spectrum, which is a line spectrum with all characteristic lines superimposed above a certain fluctuating background. Other interaction processes, mainly the elastic and inelastic scattering of the primary radiation on sample and substrate, induce the background [16].Measurement of the spectrum of the emitted characteristic fluorescence radiation is performed using wavelength dispersive (WD) and energy dispersive (ED) spectrometers. In wavelength dispersive X-ray fluorescence analysis (WDXRF), the result is an intensity spectrum of the characteristic lines versus wavelength measured with a Bragg single crystal as dispersion medium while counting the photons with a Geiger-Müller, a proportional or scintillation counter. In energy dispersive X-ray fluorescence analysis (EDXRF), a solid-state detector is used to count the photons, simultaneously sorting them according to energy and storing the result in a multichannel memory [16].The result is X-ray energy vs. intensity spectrum. The range of detectable elements ranges from be (Z = 4) for the light elements and goes up to U (Z = 92) on the high atomic number Z side. The concentrations that can be determined with standard spectrometers of WD or ED type lie are situated in a wide dynamic range: from the percent to the μg/g level. In terms of mass the Nano gram range is reached with spectrometers having the standard

excitation geometry [16].The most striking feature of XRF analysis is that this technique allows the qualitative and quantitative analysis of almost all the elements (Be−U) in an unknown sample. The analysis is in principle nondestructive, has high precision and accuracy, has simultaneous multielement capacity, requires only a short irradiation time so that a high sample throughput is possible; on-line analysis is also possible and the running costs are low. The technique is extremely versatile for applications in many fields of science, research and quality control, has low detection limits, and a large dynamic range of concentrations covering up to 9 orders of magnitude. The physical size of an XRF spectrometer ranges from handheld, battery-operated field units to high-power laboratory units with compact tabletop units and larger ones requiring several cubic meters of space including a 10−20 kW electrical power supply and efficient cooling units with high pressure water and a heat sink [16].In contrast to all these attractive properties there are some disadvantages. The absorption effects of the primary radiation and the fluorescence radiation created in the analyze result in a shallow layer a few tenths of a millimeter deep that provides information on its composition. This requires a perfectly homogeneous sample which often occurs naturally but must sometimes be produced by acid dissolution into liquids or by grinding and the preparation of pressed pellets. In both examples the feature of non-destructiveness is lost [16].

3.3.2 Application of X-Ray Fluorescence

The confocal geometry uses two polycarpellary focusing optics for enhanced applications of XRF elemental analysis. An excitation optic focuses a small X-ray beam onto the specimen. A detection optic collects fluorescent X-rays from the sample. Specifically, elemental concentrations are measured within the small probe volume (″confocal volume″) defined by the intersection of the output focal spot of the excitation optic and the input focal spot of the collection
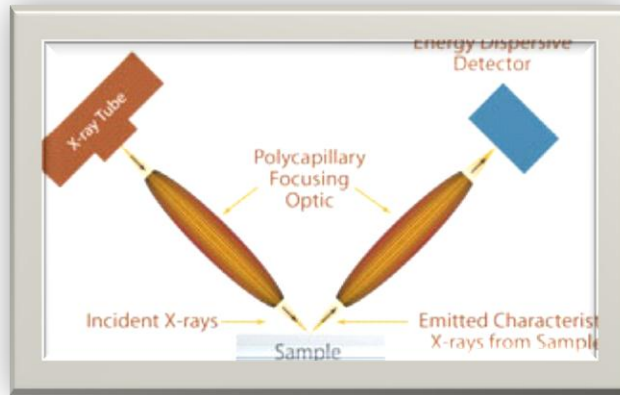
optic(see fig.3.2)[17].

.

Figure3.2. System of XRF

This method can be used to detect and quantify elements within radioactive materials.The polycarpellary focusing optics act as spatial filters to eliminate background radiation from the sample and increase detection sensitivity for sample elements of interest. Additionally, confocal XRF can be used for elemental depth profiling. Confocal XRF acts as a material probe by exciting and detecting emitted characteristic X-ray photons from within the confocal analysis volume as this volume is through the sample. In this way elemental concentrations can be measured on the object′s surface and throughout the object′s interior. Confocal X-ray fluorescence with X-ray optics has been used for many unique applications including thin film thickness measuremenforensics, art restoration, and small feature analysis .

3.4 UV Spectrometer

Refers to absorption spectroscopy or reflectance spectroscopy in the ultraviolet - visible spectral region .This means it uses light in the visible and adjacent ranges. The absorption or reflectance in the visible range directly affects the perceived color of the chemicals involved .In this region of the electromagnetic spectrum, atoms and molecules undergo electronic transitions. Absorption spectroscopy is complementary to fluorescence spectroscopy, in that fluorescence deals with transitions from the excited state to the ground state, while absorption measures transitions from the ground state to the excited state. UV-Vis spectroscopy is also used in the semiconductor industry to measure the thickness and optical properties of thin films on a wafer. UV-Vis spectrometers are used to measure the reflectance of light, and can be analyzed via the For ouhi-Bloomer dispersion equations to determine the Index of Refraction (n)and the Extinction Coefficient (k) of a given film across the measured spectral range. Samples for UV/Vis spectrophotometer are most often liquids, although the absorbance of gases and even of solids can also   be measured. In addition, ultraviolet-visible spectrophotometers can be used to determine the thickness, along with the refractive index and extinction coefficient of thin films as described in Refractive index and extinction coefficient of thin film materials. Basic UV-Visible device components: The basic parts of a spectrophotometer are a light source, a holder for the sample, a diffraction grating in a monochromatic or a prism to separate the different wavelengths of light, and a detector[17].

3.5Method

The mica samples were taken and were placed in XRF device for testing to detect the elements that make the samples and their concentrations then in UV device for knowledge optical properties was taken as shown in fig 3.5.

Fig.3.3.XRF device

Fig.3.4. UV device

Chapter Four

Results and Discussions

4.1 Introduction

In This Chapter they obtained results was discussed and conclusion and Recommendations were presented.

4.2 Results

Table 4.1 shows the elements and concentration in mica. The first column represents the elements of mica and second column shows their concentration for mica.

Table 4.1 the elements and their concentration in mica.

The elements	Concentration%
Fe	38.60
Mo	2.05
Cr	0.81
Zn	0.01
W	7.30
V	0.98
Pb	0.00
Ni	0.73

The UV spectroscopy of mica in which the relation between wavelengths and absorption were appeared. sample 1(10mm)and sample 2(22mm) are represented in figs 4.1 and 4.2 respectively.
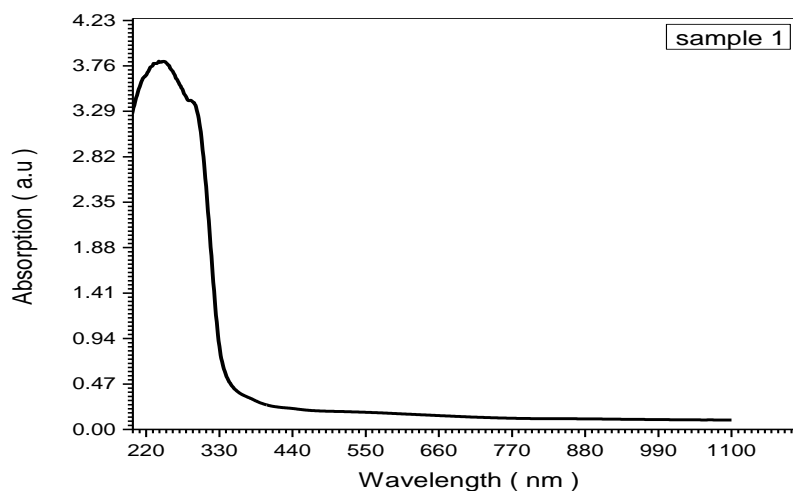
Fig4.1.The relation between wavelengths and Absorption
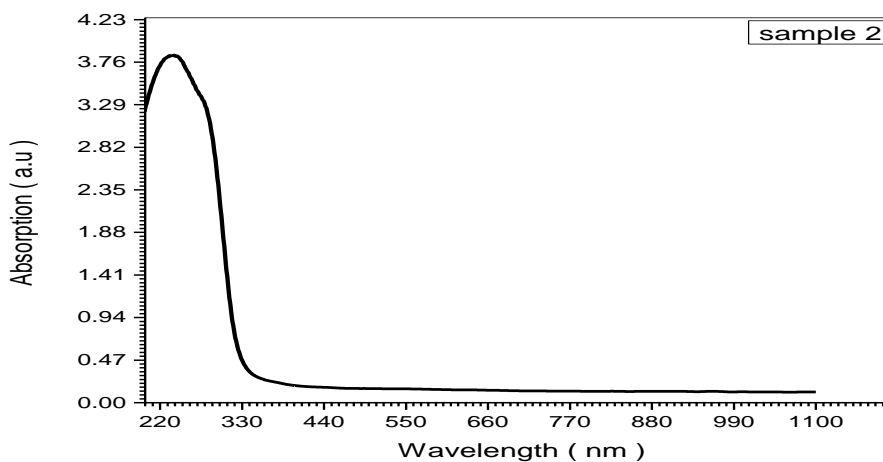
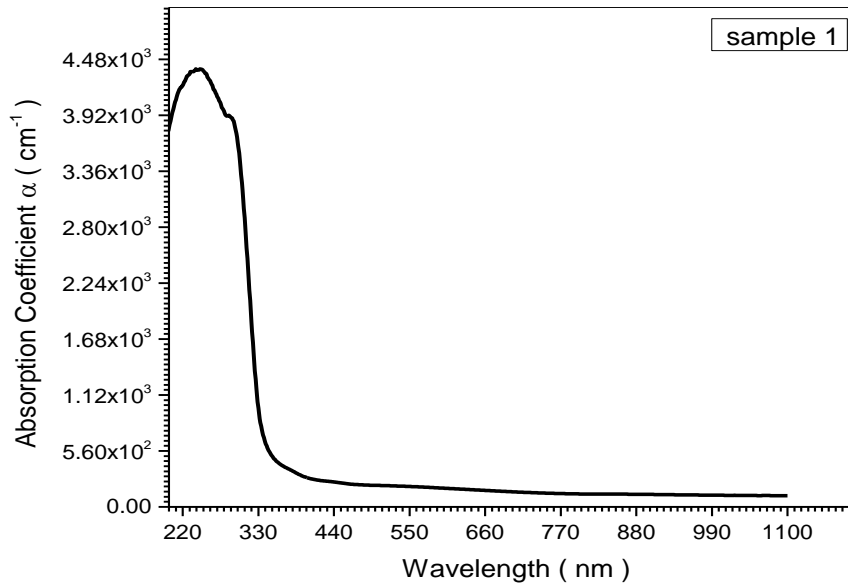**Fig4.2.The relation between wavelengths and Absorption**

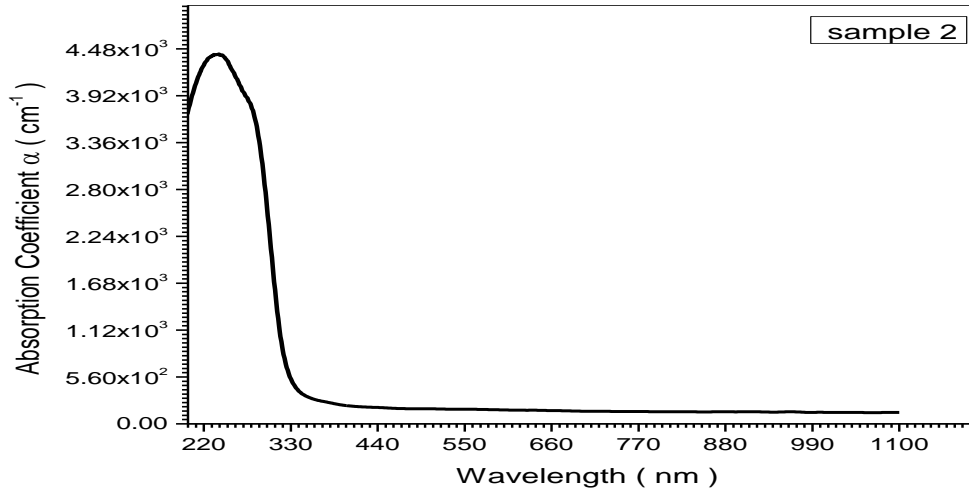**Fig.4.3.The relation between wavelengths and Absorption Coefficient**

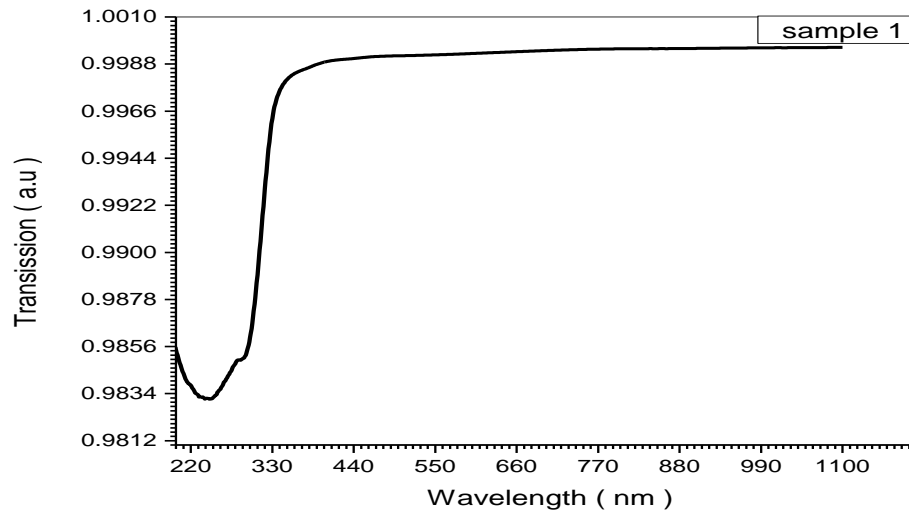**Fig. 4.4. The relation between wavelengths and Absorption Coefficient**

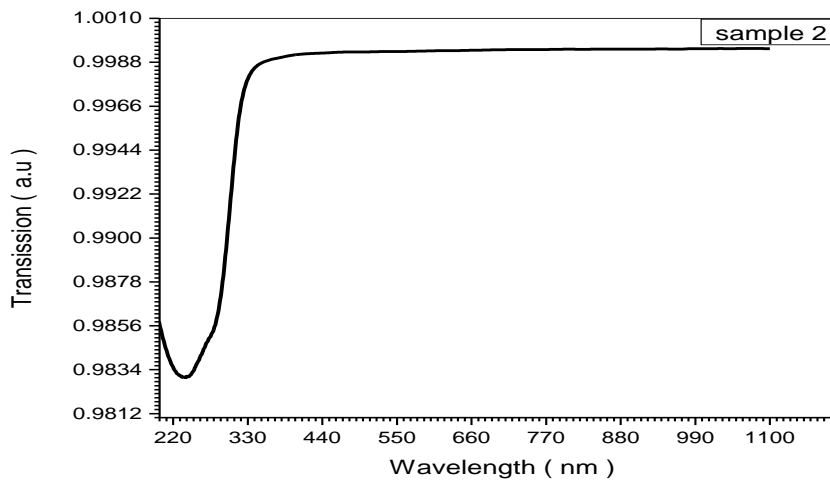**Fig.4.5. The relation between wavelength and transmission**

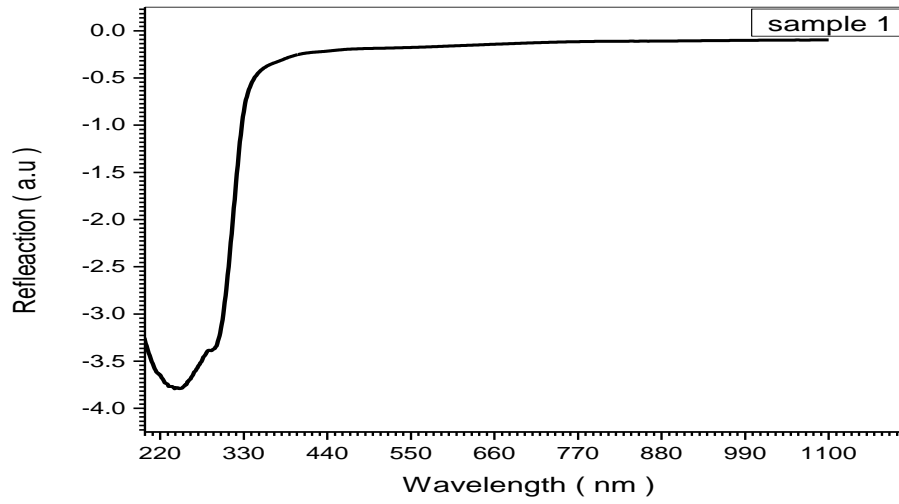**Fig.4.6. The relation between wavelengths and Transmission**

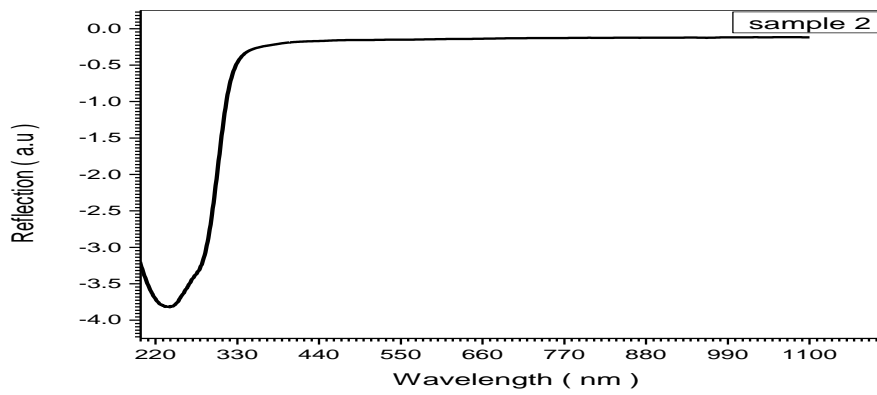**Fig.4.7.The relation between wavelengths and Reflection**

Fig.4.8.The relation between wavelengths and Reflection

4.3Discussion

The relation between wavelengths and absorbance of sample1, and sample2 were studied which were shown in figs. 4.1and 4.2.The absorption scanning from $220nm$ to $1100nm$ for each samples. The high absorbance for sample1 was $3.77au$, whereas the high absorbance for sample2 is $3.78au$ which less than in the wavelength $330nm$ .This was increase for high absorbance attributed to thickness of mica.

From figs. 4.3 and 4.4 it clear that the relation between wavelengths and Absorption Coefficient for sample1 and sample2, the scanning range $(220-1100nm)$. The high absorption coefficient less than $4.42\times10^3 cm^{-1}$ in the wavelength $330nm$ for all samples of mica(same material).

The relation between wavelength and Transision of sample1and sample2 are all most of transmission in the end of UV and visible and IR there is no absorption due to chemical composition which were shown in figs. 4.5 and 4.6.

From figs.4.7 and 4.8 shown the relation between wavelengths and Reflection of sample1 and sample2. From these figs shown the reflection is so weak.The reason attributed to these samples are not reflectance the waves or not suitable for being a mirror.

The elements compounds (Fe,Mo,Cr,Zn,W,V,Pb,Ni) of mica samples as shown in table 4.1 were important to how utlize this samples for any applications.

4.4 Conclusion

> The two samples of mica were prepared for different thickness $(10,22mm)$ and impacted by the U.V spectrometers to measure their absorption spectrum in ranged $(330-1100nm)$. The optical parameters were calculated.

> There was a similarity in all optical properties of both samples except absorption in the sample 1 which was equals 3.77au and absorption in the sample 2 which was equals 3.78au.due to the difference in thickness.

4.5 Recommendations

> More measurements particularly the structural (SEM and TEM).

> measurements the electrical properties.

4.6 References

[1]Kirkpatrick, E. M., ed. (1983). Chambers 20th Century Dictionary. Schwarz, Davidson, Seaton, Simpson, Sherrard (New ed.). Edinburgh: W & R Chambers Ltd. p. 793. ISBN 0550102345.

[2] Fagan, Garrett G. (2006). Archaeological Fantasies: How PseudoarchaeologyMisrepresents the Past and Misleads the Public. New York: Routledge. p. 102. ISBN 0415305934.

[3]Dolley, Thomas P. (2008) "Mica"Archived 2011-10-30 at the WaybackMachine. in USGS 2008 Minerals Yearbook.

[4]Dehlvi, Sadia (October 14, 2007). "Tradition and modernity". Dawn.com. Archived from the original on October 20, 2013.

[5]Ramzi, Shanaz (March 31, 2005). "Fashion through the ages". Dawn.com. Archived from the original on October 20, 2013.

[6]Dolley, Thomas P. (2008) "Mica"Archived 2011-10-30 at the WaybackMachine. in USGS 2008 Minerals Yearbook.

[7] Copyright ©2006-2017 rocksandminerals 4u.com.

[8] http://www.adhunikudyog.com/what...

[9]Functional Polymer Films Eds. R. Advincula and W. Knoll – Wiley, 2011, ISBN 978-3527321902.

[10]Copyright ©2006-2017 rocksandminerals 4u.com.

[11] Dolley, Thomas P. (2008) "Mica"Archived 2011-10-30 at the WaybackMachine. in USGS 2008 Minerals Yearbook.

[12]Frank L.Pedrotti,.S.J.,Leno S.Pedrotti(1993) "Introdion to Optics",2th edition prentice-hall.Inc.New jersy.

[13]J.Michael Holla.(1996) "Modern Spectroscopy"3[td] edition New York

[14]F.J.Duart.(1995) "Tunable Laser Handbook"Academic Press,London.

[15]Alan Corney. (1977)"Atomic and Laser Spectroscopy".Claredon Press,Oxford

 [16] M.Srikanth*, G.Venkateswara Rao and K.R.S.Sambasiva Rao, Indian Journal of Clinical Biochemistry, 2004, 19 (1) 34-35].

[17] https://doi.org/10.1016/j.toxac.2014.09.058.