

Sudan University of Science and Technology

College of Graduate Studies and scientific research

**Measurement and Evaluation of Absorption
Coefficient of Some Materials for Lasers in
Infra Red Region**

**قياس وتقويم معامل امتصاص بعض المواد
لليزرات في منطقة الاشعة تحت الحمراء**

A thesis submitted as a partial fulfillment of the requirements for
the degree of master in laser applications in physics

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الله الرحمن الرحيم بسم

أَللَّهُ نُورٌ السَّمَوَاتِ وَالْأَرْضِ مِثْلُ
نُورِهِ كَمِشْكَاةٍ فِيهَا مِصْبَاحٌ الْمِصْبَاحُ فِي زُجَاجَةٍ الزُّجَاجَةُ
كَأَنَّهَا كَوْكَبٌ دُرِّيٌّ يُوقَدُ مِنْ شَجَرَةٍ مُبَارَكَةٍ زَيْتُونَةٍ لَا شَرْقِيَّةٍ وَلَا
غَرْبِيَّةٍ يَكَادُ زَيْتُهَا يُضِيءُ وَلَوْ لَمْ تَمْسَسْهُ نَارٌ نُورٌ عَلَى نُورٍ
يَهْدِي اللَّهُ لِنُورِهِ مَنْ يَشَاءُ وَيَضْرِبُ اللَّهُ الْأَمْثَلَ لِلنَّاسِ وَاللَّهُ
بِكُلِّ شَيْءٍ عَلِيمٌ ﴿٣٥﴾

صدق الله العظيم

سورة النور

(الاية 35)

DEDICATION

To

my parents

my family

my teachers

my friends

and

all persons

who be devoted to me

Moawia

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Abstract

In this study 3 types of materials selected: lead sulfate (PbSO_4), zinc sulfide (ZnS), mixture of lead sulfate (PbSO_4) and zinc sulfide (ZnS) and antimony trioxide (Sb_2O_3), which undergoes spectroscopical analysis using FT-IR spectrometer before and after irradiation by different wavelengths (810, 820, 1064) nm in IR region. Selected materials divided into four groups, five discs ($D=1.4\text{cm}$) were manufactured from each group by using pressing machine. Incident intensity (I_0) and transmitted intensity (I) through materials measured using three laser sources (diode laser $\lambda=810\text{nm}$ $P=100\text{mW}$, diode laser $\lambda=820\text{nm}$ $P=200\text{mW}$ and Nd: YAG laser $\lambda=1064\text{nm}$ $P=10\text{W}$), Laser sources used to irradiate the materials then incident intensity (I_0) and transmitted intensity detected by photoelement and then readout using digital multimeter. The relation between the ratio of transmitted to incident intensity (I/I_0) and thickness has been plotted and absorption coefficient determined. The results showed that lead sulfate (PbSO_4) has absorption coefficients (0.01258, 0.05352, 0.03617) cm^{-1} for wavelengths (810, 820, 1064) nm respectively. (PbSO_4) can be used to fabricate filter at wavelengths (810, 1064) nm with high efficiency. Zinc sulfide (ZnS) has absorption coefficients (0.05624, 0.04155,

0.07421) cm^{-1} for wavelengths (810, 820, 1064) nm respectively. (ZnS) can be used to fabricate attenuator at wavelength (1064) nm with high efficiency, also can be used to fabricate filter at wavelength (820) nm, with moderate efficiency. Mixture of lead sulfate (PbSO_4) and Zinc sulfide (ZnS) has absorption coefficients (0.05331, 0.03874, 0.0847) cm^{-1} for wavelengths (810, 820, 1064) nm respectively. This material can be used to fabricate attenuator at wavelength (1064) nm with high efficiency; also can be used to fabricate filter at wavelength (820) nm with moderate efficiency. The antimony trioxide (Sb_2O_3) has absorption coefficients (0.03495, 0.05905, 0.04496) cm^{-1} for wavelengths (810, 820, 1064) nm respectively. (Sb_2O_3) can be used to fabricate filter at wavelength (810) nm with high efficiency.

الخلاصة

فى هذه الدراسة أختيرت 3 أنواع من المواد هى كبريتات الرصاص, كبريتيد الزنك, خليط من كبريتات الرصاص و كبريتيد الزنك, وثالث اوكسيد الأنتيمون, و حللت طيفيا باستخدام مطياف فى منطقة الأشعة تحت الحمراء قبل وبعد تشيعيها باطوال موجية مختلفة فى منطقة الأشعة تحت الحمراء (820,810, 1064, نانومتر. قسمت المواد المختارة الى اربع مجموعات, صنعت خمسة أقراص(بقطر 1.4 سم) من كل مجموعة باستخدام ماكينة ضاغطة.تم قياس شدة الأشعة الساقطة والنافذة خلال المواد بأستخدام ثلاثة مصادر لليزر(ليزرالدايود ذوالطول الموجي 810 نانومتربقـدرة 100 ملي واط, ليزرالدايود ذو الطول الموجي 820 نانومتربقـدرة 200 ملي واط, وليزرالنيديوم ياق(1064) نانومتر بقـدرة 10 واط,تم تشيع المواد بأستخدام مصادرالليزر وتم قياس شدة الأشعة الساقطة والنافذة بواسطة كاشف ضوئى وتم قرائتها على قولتميترملحق بالكاشف. تم تمثيل العلاقة بين النسبة شدة الأشعة النافذة والساقطة, والسمك ومن ثم حساب معامل الأمتصاص.

اوضحت النتائج ان كبريتات الرصاص لها معاملات امتصاص (0.01258,0.05352,0.03617) سم⁻¹ للأطوال الموجية (810,820 , 1064) نانومتر على الترتيب. يمكن استخدام كبريتات الرصاص كمرشح بكفاءة عالية للطولين الموجيين (810 و 1064). كبريتيد الزنك له معاملات امتصاص (0.05624,0.04155,0.07421) سم⁻¹ للأطوال الموجية (810, 820, 1064) نانومتر على الترتيب . يمكن استخدام كبريتيد الزنك كموهن بكفاءة عالية للطول الموجي (1064 نانومتر) كما يمكن استخدامها كمرشح و بكفاءة متوسطة للطول الموجي (820 نانومتر). خليط كبريتات الرصاص و كبريتيد الزنك الرصاص لها معاملات امتصاص (0.05331,0.03874,0.0847) سم⁻¹ للأطوال الموجية (810,820 , 1064) نانومتر على الترتيب . يمكن استخدام الخليط كموهن بكفاءة عالية للطول الموجي (1064 نانومتر, كما يمكن استخدامها كمرشح و بكفاءة متوسطة للطول الموجي (820 نانومتر). ثالث اوكسيد الأنثيمون له معاملات امتصاص (0.03495,0.05905,0.04496) سم⁻¹ للأطوال الموجية (810, 820, 1064) نانومتر على الترتيب . يمكن استخدام ثالث اوكسيد الأنثيمون كمرشح بكفاءة عالية للطول الموجي (810) نانومتر.

CONTENTS

CHAPTE ONE: THEORITICAL BACKGROUND

1.1Introduction

1

1.2. The Electromagnetic Spectrum

1

1.3. Filters

4

1.3.1. Attenuation Filters

5

1.3.1.1 Geometrical Filters

5

1.3.1.2 Neutral-density Filters

6

1.3.2. Wavelength-selective filters

6

1.3.2.1. Cut-off filters

8

1.3.2.2. Band pass filters

8

1.3.2.3. Compensating filters

9

1.3.3. Polarization Filters

10

1.4. Optical window

10

1.5. Properties of Laser beams

11

1.5.1. Monochromaticity

11

1.5.2. Coherence

12

1.5.3. Directionality

12

1.5.4. Brightness

13

1.6. IR Frequency Range and Spectrum Presentation

14

1.6.1. Mid-Infrared Region

14

1.6.2 Near-Infrared Region

14

1.6.3. Far-Infrared Region

14

1.7. Infrared Spectroscopy

15

15	1.7.1.	Infrared	spectrum
16	1.7.2.	Infrared	Absorptions
18	1.7.3.	Normal Modes of	Vibration
19	1.7.4.	Theory of Infrared	Absorption
20	1.8.	Infrared	Spectrometers
20	1.8.1.	Dispersive Infrared	Spectrometers
21	1.8.2.	Fourier-Transform Infrared	Spectrometers
24	1.8.3.	Sources and	Detectors
24	1.9.	Beer's	Law
28	1.10.	Literature	Review

1.11.	Objective	of	the	work
30				

CHAPTR TWO: MATERIALS AND METHOD

2.1.	Introduction
31	

2.2.	Materials
31	

2.2.1.	Lead	sulfate	(PbSO ₄)
31			

2.2.2.	Zinc sulfide (ZnS)
31	

2.2.3.	Antimony	trioxide	(Sb ₂ O ₃)
32			

2.2.4.	Potassium	Bromide	(KBr)
32			

2.3.	Equipment and tools
32	

2.3.1.	Pressing Machine
32	

2.3.2.	Electronic Balance
33	

2.3.3. Detector	
33	
2.3.4. Digital Multimeter	
33	
2.3.5. Vernier	
33	
2.3.6. Laser Sources	
33	
2.3.6.1. The Semiconductor Diode laser system	
33	
2.3.6.2. The Semiconductor Diode laser system	
33	
2.3.6.3. The Nd: YAG laser system	
34	
2.3.7. FT IR Spectrometer	
34	
2.4. Set up and methodology	
35	
2.4.1. Disc fabrication	
35	
2.4.2. Spectroscopical analysis	
36	

2.4.3. Sample irradiation

36

CHAPTER THREE: RESULTS AND DISCUSSION

3.1. Introduction

37

3.2. Disc fabrication

37

3.3. Group one

39

3.3.1. Group one spectroscopic analysis

39

3.3.2. Group one sample irradiation

40

3.3.3. Group one absorption coefficient calculation

42

3.3.4. Group one discussion

43

3.4. Group two

43

3.4.1. Group two spectroscopic analysis

43

3.4.2. Group two sample irradiation
44

3.4.3. Group two Absorption coefficient calculation
47

3.4.4. Group two discussion
48

3.5. Group three
48

3.5.1. Group three Spectroscopic analysis
48

3.5.2. Group three Sample irradiation
49

3.5.3. Group three Absorption coefficient calculation
52

3.5.4. Group three Discussion
52

3.6. Group four
53

3.6.1. Group four spectroscopic analysis
53

3.6.2. Group four sample irradiation
53

3.6.3. Group four absorption coefficient calculation
56

3.6.4. Group four discussion
57

3.4. Conclusion
57

3.5. Recommendations
58

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