

Study the Electrical Conductivity for a New Azo Compound

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Abstract

New two azo dyes Biphenyl-4,4- bis(4-Azo-8-hydroxy aquolinol) and Biphenyl-4,4 bis (4-Azo-8-hydroxy aquolinol) were prepared. The prepared by fox method, dyes were identified via FTIR-Infrared spectrophotometer and UV-visible spectroscopy. The electrical properties were measured and the result was obtained on conductivity arrived to 10^{-6} ohm $^{-1}$. cm $^{-1}$ with undoping.

Keywords: Electrical Properties, Azo Compound Derivative from Diaminodiphen

Introduction

Azo dyes contain one or more azo groups (- N =N -) which are linked to SP² hybridized carbon atoms, based on the number of such groups [1]. The dyes known as monoazo dyes have only one (-N = N -) group while diazo and triazo dyes contain two and three (- N = N -) group, respectively. The azo groups are generally connected to benzene and naphthalene rings, but can also be attached to aromatic heterocycles or enolizable aliphatic groups [2]. Synthetic dye manufacturing started in 1856, when the English chemist W.H. Perkin, in an attempt to synthetic quinine, obtained instead a bluish substance with excellent dyeing properties that later became known as aniline purple, Tyrian purple or mauveine. Perkin, 18 years old, patented his invention and set up a production line. This concept of research and development was soon to be followed by others and new dyes began to

appear on the market, a process that was strongly stimulated by Kekules discovery of the molecular structure of benzene in 1865. In the beginning of the 20th century, synthetic dyestuffs had almost completely supplanted natural dyes^[3]. The synthesis of most azo dyes involves diazotization of a primary aromatic amine, followed by coupling with one or more nucleophilic aromatic compound such as an aryl amine or a phenol [4]. Azo dyes are the most important class of industrial dyes, both in number and amount. In addition, azo dyes have found wide application in dyeing wool, polyamide fiber, semi conductivity textile and food industries [5]

In the present study a new azo compounds were prepared and Identification by IR, U. V-Visible spectroscopy and study the Electrical properties.

Experimental

Materials

Acetone, biphenyldiamine, 8- hydroxy-aquinolinol, 1- naphthol from (Fluka Co), hydrochloric acid,

sodium nitrite, sodium hydroxide from (Merck Co), were purified before using [6].

Instruments

1 – IR- Infrared spectrophotometer from made by (Buck Scientific) Model 500, in the range (4000 – 600) cm $^{-1}$, in Department of Chemistry / College of Education/ Basrah University.

2– U.V-Visible spectrophotometer, Model-U-1500- HITACH, Department of Chemistry / College of Education/ Basrah University.

3 – Melting Point, Model – Electro thermal melting point 9300 , Department of Chemistry / College of Education / Basrah University.

4 – Electrical Conductivity (voltmeter, power supply, Resistance, Temperature Recorded and measured sample cell) were used under vacuum Department of Chemistry / College of Education/ Basrah University.

Methods

Synthesis of Biphenyl-4,4- bis(4-Azo-8-hydroxy aquolinol) [7]

1.8 g of benzidine was dissolved in 10 ml of concentrated hydrochloric acid (1M) and 175 ml of water were added and cooled the solution at (0-5) °C. Then the solution of 2 g sodium nitrite in 50 ml of water was prepared and added to the previous solution on dropwise at (0-5)°C.

A solution of 2.9 g 1- naphthaol and 1g sodium hydroxide in 150 ml of water added to the mixture

After stirring for 30min the product recovered by filtration, washed with distilled water and dried under vacuum. The structure product was showed in figure (1). The product has a violet color and the melting point was more than > (300°C). its decomposition in (341-342).

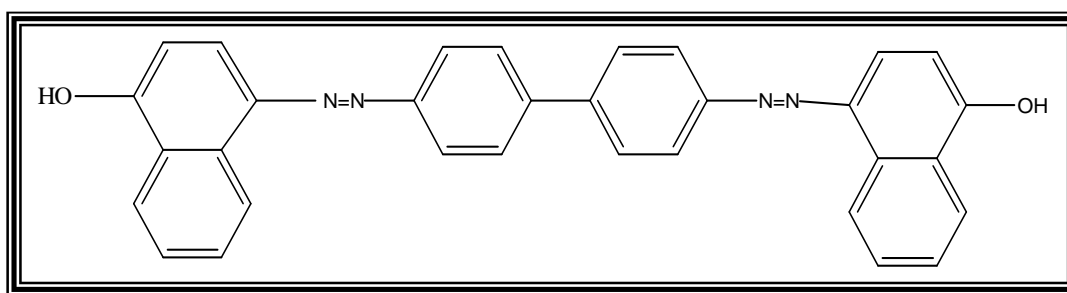


Figure (1) Violet Color

Synthesis of Biphenyl-4,4 bis (4-Azo-8-hydroxy aquolinol) [8]

1.8 g of benzidine was dissolved in 10 ml of concentrated hydrochloric acid and 175 ml of distilled water and the solution cooled at (0-5)°C. The the solution of 2 g sodium nitrite in 50ml of water was prepared and added to the previous solution on dropwise at (0-5) °C. A solution of 2.9 g 8-hydroxy qunoline and 1g sodium hydroxide in

150 ml of water was added to the mixture .After stirring for 30min the product recovered by filtration, washed with distilled water and dried under vacuum. The structure product as shown in figure (2). The product has orange color and the melting point was more than >(300°C). its decomposition in (355 -356.3).

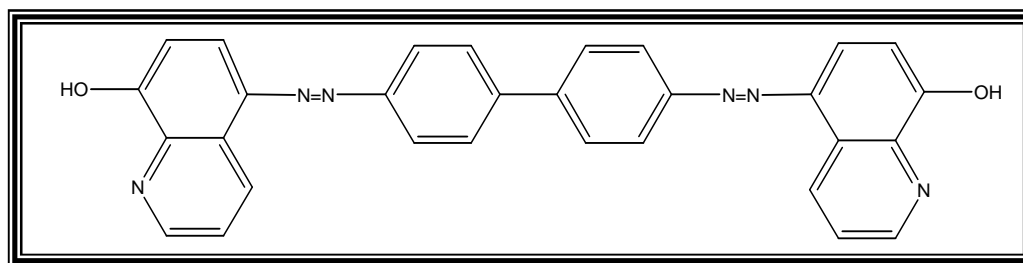


Figure (2) Orange Color

Conductivity Measurement [9]

The electrical conductivities were measured by using the (Voltmeter, resistance, power supply, sample cell, temperature recorder). The conductivities were calculated according to the Ahrrenius equation as shown below (1)

$$\sigma = \sigma_0 * \exp (-\Delta E/2K) \dots\dots (1)$$

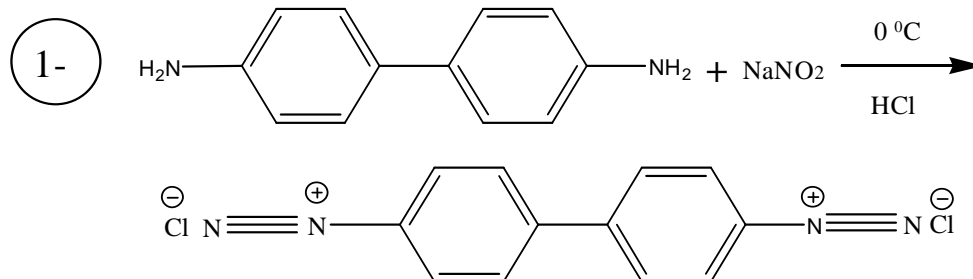
σ = Conductivity (ohm⁻¹ . cm⁻¹)
 σ_0 = Pre – exponential conductivity (ohm⁻¹ . cm⁻¹)
 ΔE = Energy gap (eV)
 K = Boltzmann constant (eV)
 T = Temperature (Kelvin)

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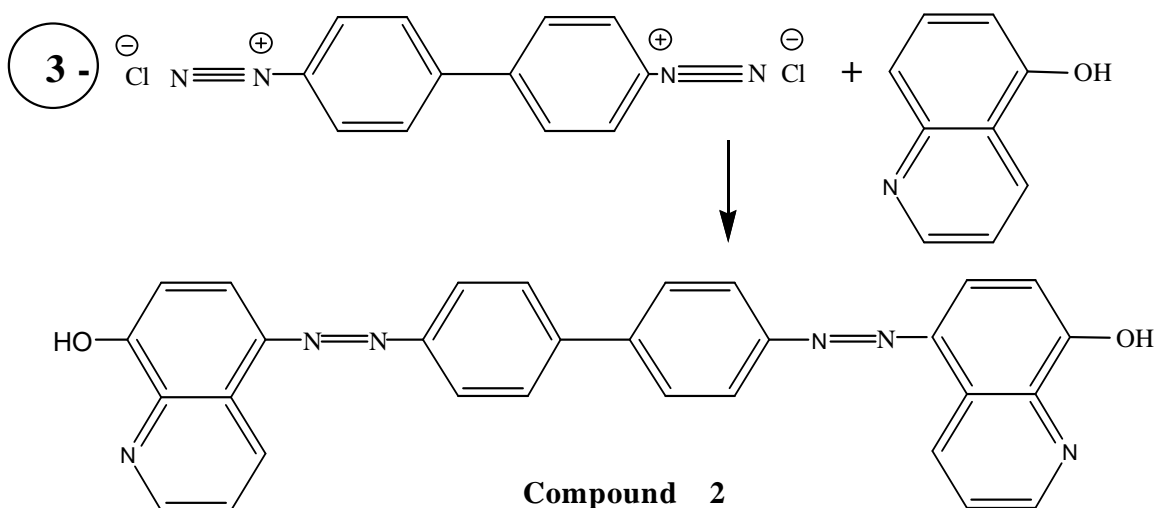
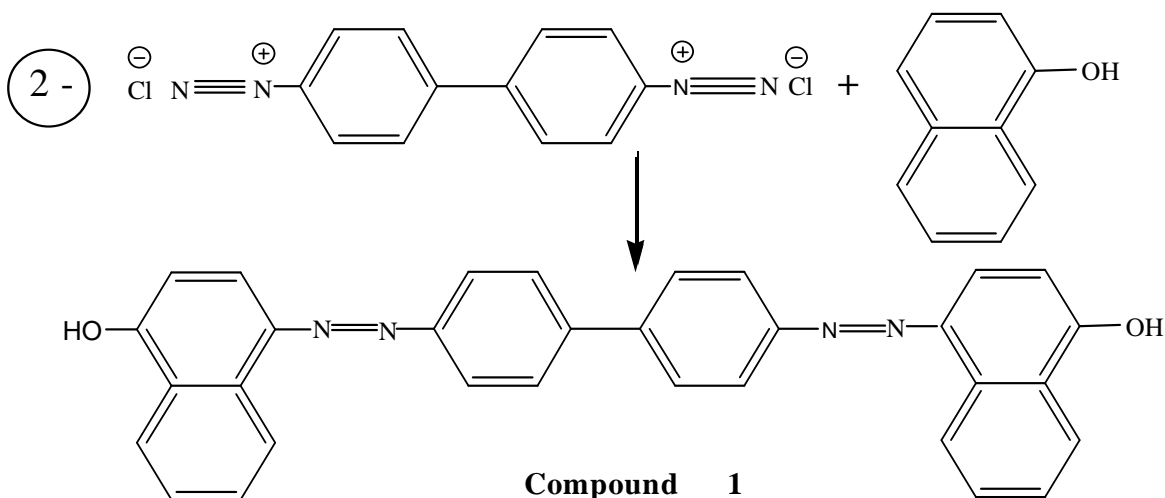
which applied for the prepared azo compound .The prepared azo compounds were in discs form and

covered by silver paint in two sides, The equation was applied.

Scheme representing the prepared azo compounds



Diazonium Compound



Results and Discussion

IR. Spectroscopy ^[10]

In the present study, the azo compounds were identified by IR. spectrophotometer in the range (4000–600) cm^{-1} and form KBr discs as shown in figures (5) and (6).

The I.R spectra for compounds (1 and 2) showed absorption bands at (3355 cm^{-1}) which may be attributed to the (OH) group , and another two distinguished bands at (1640 – 1605 cm^{-1}) was to

the stretching vibration of the (-N=N-) azo groups, while the band (1615–1515 cm^{-1}) was to the stretching vibration of the (C=C) group. Also the weak band at (1240 cm^{-1}) for stretching vibration of (C-O) group, where as the band at (1015 cm^{-1}) was related to stretch vibration of (C-N) group. The major absorption bands for compounds (1 and 2) are shown in Table (1).

Table (1) the Characteristic Bands of Compounds (1 & 2)

Compound	ν O-H cm^{-1}	ν C-H cm^{-1}	ν C-O cm^{-1}	ν C=C cm^{-1}	ν N=N cm^{-1}	ν C-N cm^{-1}
1	3350 br	3025 w	1240 m	1615 s	1620 s	1015 m
2	3355 br	3020 w	1240 s	1515 w	1605 s	1015 w

br = broad, s = strong, m = medium, w = weak,

U.V – Visible Spectra

The electronic absorption spectra for the prepared compounds (1&2) were measured in acetone solvent. The U.V spectra was recorded in the range of (300–500nm) as shown in figs (3 and 4). The essential absorption of the prepared compounds were appeared at (390 nm) and (370

nm) for compound 1 and 2 respectively. these bands may be attributed to ($\pi \rightarrow \pi^*$) transition in aromatic system. In addition to the presence of (-N=N-) group which increased from the delocalization of charge carriers on the ring systems.

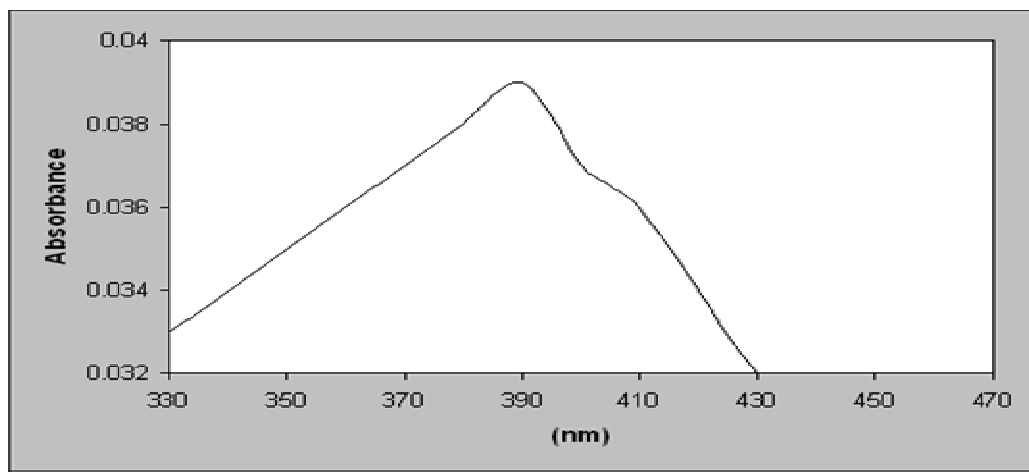


Figure (3) The U.V-Visible Spectrum of Compound (1)

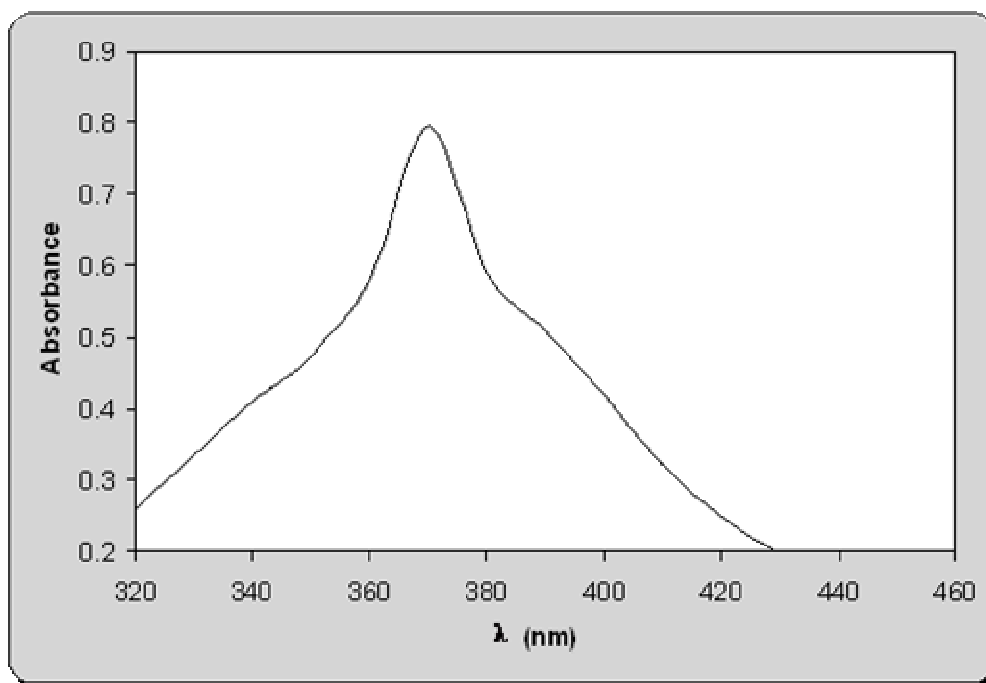


Figure (4). The U.V-Visible. Spectrum of Compound (2)

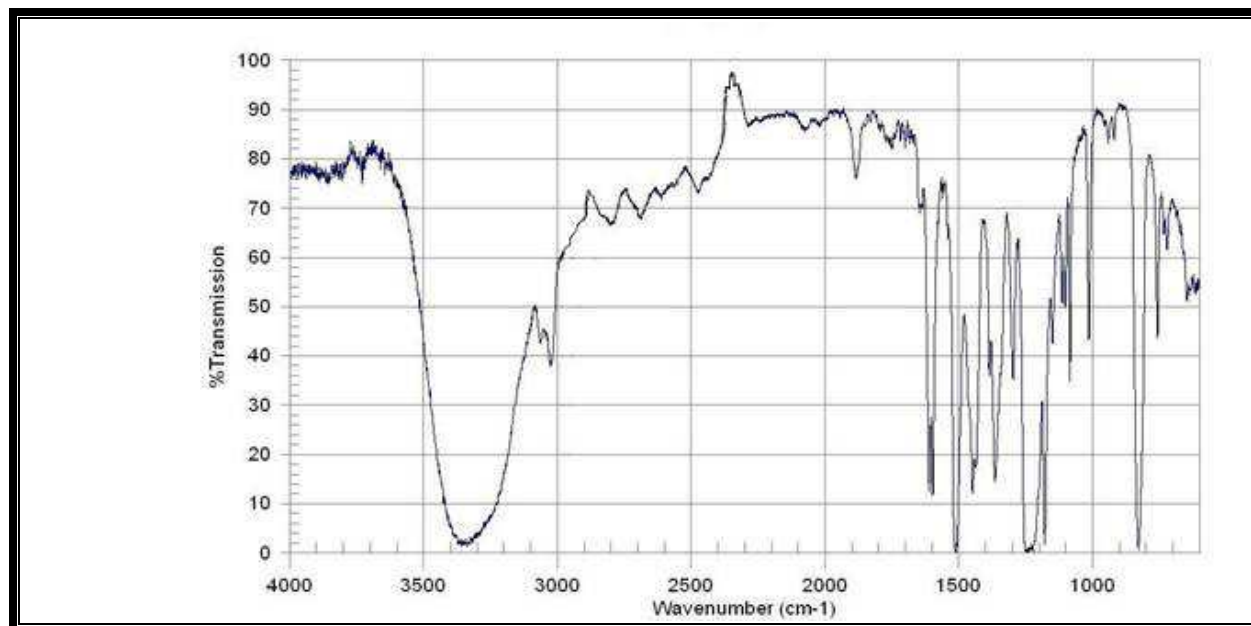


Figure (5) The I.R Spectra of Compound (1)

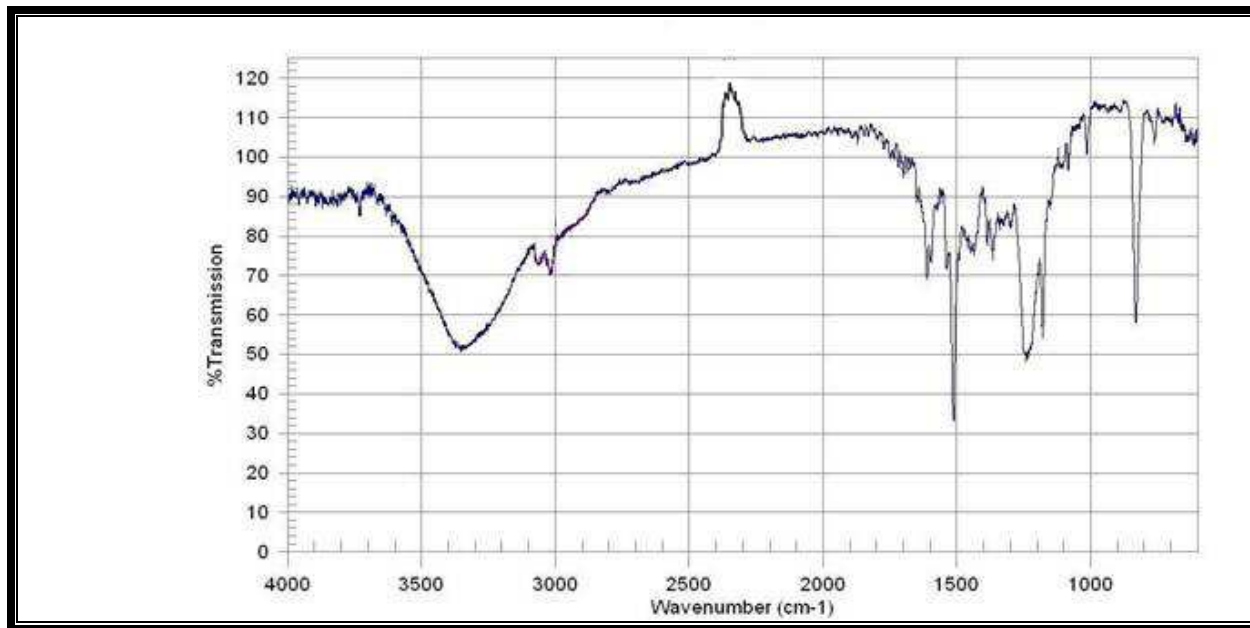


Figure (6) The I.R Spectra of Compound (2)

Electrical Properties

The d .c. electrical conductivity was measured for a compacted disc(In form discs and covered by silver paint in two sides) for the studied compounds by using a two probe method at a temperature range (303–373)k. Heating and cooling runs showed almost a similar behavior with no evidence of hysteresis.

Figure (7) shows the d.c. conductivity of compounds (1) and (2) at different temperatures. It shows that the compound (2) has higher

conductivity than the compound (1) this behavior be attributed to the presence of conjugation along the compound (2). In addition, the compound (2) has a donor group (N- atom) which increases the distribution of electron density along the compound while the compound (1) is uncontained on (N-atom) in a ring system which decreases the electron density along the compound . The values of conductivity is shown in Table (2).

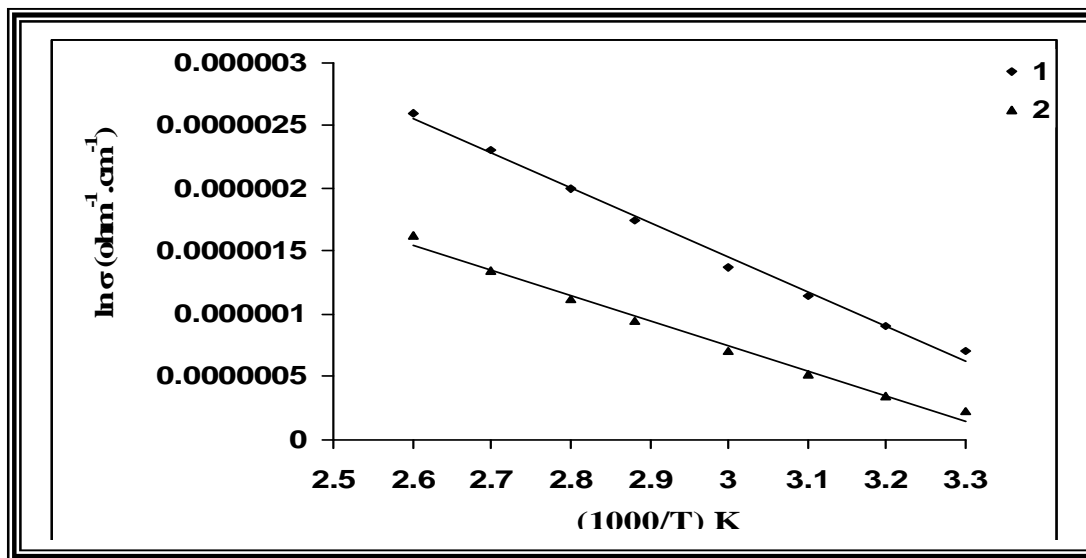


Figure (7) the Electrical Conductivity for Azo Compound (1 & 2)

Table (2) the Values of Conductivity for the Prepared Azo Compounds (1 & 2)

Compound	σ ($\text{ohm}^{-1} \cdot \text{cm}^{-1}$)	σ_0 ($\text{ohm}^{-1} \cdot \text{cm}^{-1}$)	ΔE (eV)
1	$4.593 \cdot 10^{-7}$	$1.86 \cdot 10^{-6}$	0.443
2	$8.432 \cdot 10^{-7}$	$2.75 \cdot 10^{-6}$	0.365

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دراسة التوصيلية الكهربائية لبعض الصبغات الأزوية الجديدة

الخلاصة :

تم في هذه الدراسة تحضير نوعين من الصبغات الأزوية المشتقة من ثنائي فينا يل ثنائي الأمين مع كل من 8 - هيدروكسي كوينولين و 1- نفتول على التوالي . شخّصت الصبغات المحضرة بواسطة أطيف الأشعة تحت الحمراء والأشعة فوق البنفسجية . كما تم دراسة التوصيلية الكهربائية للصبغتين عند مدى من درجات الحرارة (303-373) كلفن , وقد لوحظ بأن المركب (2) يعطي أفضل قيمة للتوصيلية بالمقارنة مع المركب (1) أذ كانت التوصيلية الكهربائية لهما $7 \cdot 10^{-7}$ اوم⁻¹ . سم⁻¹ و $4.593 \cdot 10^{-7}$ اوم⁻¹ . سم⁻¹ .