

بسم الله الرحمن الرحيم



Sudan University of Science and Technology

College of Graduate studies

**Design and Implementation of Optical Fiber
Sensor Using Palladium and Zinc Oxide Films
for Hydrogen**

تصميم وتنفيذ متحسس ليف بصري للهيدروجين باستخدام شرائح البلاتيوم وأكسيد الزنك

**A thesis Submitted in Fulfillment of the Requirements
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By:

Albashir Zomrawi Mohamed Yousif

Supervisor:

Prof. Dr. Kais Abdelstar Alnaimee

Co-supervisor

Associate Prof. Abdelmoneim Mohamed Awadelgied

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بسم الله الرحمن الرحيم

(وما أوتيتم من العلم إلا قليلا)

صدق الله العظيم

الآية (85) سورة الإسراء

DEDICATION

Dedicated...

To my father,

the first one who taught me a
letter.

To my mother,

from whom I know the meaning
of life.

To my brothers, Nadir, Nagi,
Eltayeb,

the light of my way.

To my family, Tagwa To my sons,
Ahmed & Mohamed
whom I love.

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الخلاصة

خص هذا العمل لتصميم وتنفيذ متحسس لغاز الهيدروجين باستخدام شرائح البلاديوم وأكسيد الزنك. تصميم المتحسس يعتمد على مادة البلاديوم ومادة أكسيد الزنك حيث تم طلائهما على شرائح زجاجية كأفلام رقيقة قابلة لكشف غاز الهيدروجين. في هذا العمل تم تجهيز ست عينات، أربع من هذه العينات تم تجهيزها من ملدة البلاديوم وأثنين من العينات تم تجهيزها من ملدة أكسيد الزنك. وهذه الأفلام تم تحضيرها على شرائح زجاجية، وجهزت بوسطة تقنية الترسيب بالتبخير، وتم إخضاع العينات لثلاث اختبارات. الأولى هو حيود الأشعة السينية وذلك للتأكد من تبلور العينات، ثم المجهر النزي لدراسة تسطح العينات، وأخيراً المجهر الإلكتروني لمعرفة الوصف الدقيق لسطح العينات (خشونة البنية السطحية). كما تم تصميم حجرة اختبار مكعبة من اللدائن. لتطوير متحسس، يعتمد على تمرير غاز الهيدروجين خلال الحجرة ليتم إمتزازه في العينات (البلاديوم و أكسيد الزنك)، وتمرير شعاع ضوئي خلال العينات يتم إستقباله على محلل طيفي لقيسه وتسجيله بواسطة الحاسوب. أخزت ست قراءات لكل عينة تحت الضغوط الآتية -0.2، -0.3، -0.4، -0.5، -0.1 بار. وسجل الضوء النافذ خلال العينات في طيف لكل قراءة. ومن القراءات وجد أنه بزيادة تركيز غاز الهيدروجين في حجرة الإختبار تزداد شدة الضوء النافذ خلال العينات، وهذا يعني أن عينات البلاديوم وأكسيد الزنك نجحت في كشف غاز الهيدروجين. وهذا يؤكد نجاح المتحسس.

ABSTRACT

This work aimed to design and implements of optical fiber sensor based on a hydrogen-especial material that is inert to variation environment. The sensor design depends on the Palladium and Zinc Oxide coated on glass thin film that adept to detect hydrogen gas. In this research six samples have been prepared, four of them prepared from palladium metal and two other samples prepared from Zinc Oxide. Palladium and Zinc Oxide thin films were prepared on glass substrates. The Films were constructed by vaporization deposition technique, which subjects to three tests. The X-Ray Diffraction (XRD) to check the crystalline structure of the samples, Atomic Force Microscope (AFM) to study the surface flatness of samples, and the scanning electron microscope (SEM) to take images of surface topography of samples. A polymer test chamber was fabricated to contain the sample. The approach of the manufacture the sensor based on passing the gas to the chamber, which adsorbs on the sample (Palladium, or Zinc Oxide), and the light is transmitted through the sample to the CCS spectrometer to measure and recorded the signal using computer. Six readings were recorded for each sample test under pressures of -0.6, -0.5, -0.4, -0.3, -0.2 and -0.1 bar. Frequency against transmitted light intensity was then plotted for each measurement. From the data recorded, it was found that by increase of concentration of hydrogen gas in the test chamber, the sensitivity is increased linearly as the gas concentration increases, which means that the

Zinc Oxide and Palladium thin film samples successfully detect hydrogen gas.

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