

**SUDAN UNIVERSITY OF SCIENCE & TECHNOLOGY
COLLEGE OF GRADUATE STUDIES**

**Design, Fabrication, Testing of (NTC) Thermistor
Detector And Determination of Its
Physical Parameters**

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: قال تعالى

بسم الله الرحمن الرحيم

يَرْفَعُ اللَّهُ الَّذِينَ ءَامَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا
))
الْعِلْمَ دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ
((

المجادله .. 11

DEDICATION

THIS THESIS IS DEDICATED TO :-

**MY PARENTS, THE SOURCE OF INSPIRATION IN MY
LIFE**

MY BROTHERS AND MY SISTERS

MY FAMILY

FRIENDS

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Abstract

The basic idea in this thesis is to fabricate a thermal detector(Negative Temperature Coefficient (NTC)thermistor detector) that able to sense the low laser power at IR region. Fabrication was done by mixing precise ratios of metal oxides, blended each other, the mixture was dried, formed in disk shape and then sintered in a furnace at 1200°C for two hours. The electrode material was fired onto the ceramic body of sintered disk at 550°C so as to form an electrical union and mechanical bond between the ceramic body and the electrode. The fabricated thermistor disks had a good response to low laser power started from (0.1W) when it tested by diode laser at 810 & 940nm promising that it can be used in field of IR radiation detection with low cost in fabrication and ability to operate at room temperature without cooling.

In order to get a good response, an electronic circuit was designed which had ability to convert a physical input to output voltage and also had a high sensitivity to any change in physical input.

Because the physical characteristics of the fabricated thermistor have a great role in limiting the responsivity of thermistor, so, this thesis aimed to specify the parameters that describe the behavior of fabricated thermistor . The values of coefficients of fabricated thermistor disks that were obtained from experimental part are in the acceptable range, for example B constant of one of our fabricated disk (diskC1) is equal to 7704.33K while the typical value is between 5000 to 8000K. The values of Steinhart and Hart coefficients b_0, b_1, b_2 may be same or differ from fabricated disk to another according to the conditions of fabrication. For example b_0 of diskC1 is 5.13×10^{-3} while typical value of this constant for a thermistor with a resistance of 3000Ω at room temperature ($25^{\circ}\text{C} = 298.15\text{K}$) is $b_0 = 1.40 \times 10^{-3}$, the two values is close to each other, but $b_1(-2.62 \times 10^{-4})$ of our fabricated thermistor(diskC1) mainly differ from $b_1(2.37 \times 10^{-4})$ of ideal above thermistor in minus sign which may resulted due to the nature and ratios of materials that disk is fabricated from or the method of fabrication it self.

المتحسس الحراري

إن الفكرة الأساسية من هذه الأطروحة هي تصنيع متحسس حراري سلبي له القدرة على تحسس قدرة الليزر الضعيفة في المنطقة الحمراء من الطيف الكهرومغناطيسي . تم التصنيع بخلط نسب معينة من أكاسيد المعادن الفلزية التي خلطت مع بعضها البعض ثم جفف الخليط وشكل على هيئة قرص تم حرقه في فرن كهربائي عند درجة حرارة 1200 درجة مئوية لمدة ساعتين . بعد ذلك سخنت المادة الموصلة على جسم القرص عند درجة حرارة 550 درجة مئوية وذلك لكي يتشكل اتحاد كهربائي وتنشأ رابطة ميكانيكية بين جسم القرص والمادة الموصلة . كان للقرص المصنوع استجابة جيدة ل قدرة الليزر الضعيفة بدأت من (0.1 w) عندما أختبر القرص بواسطة ليزر الثنائي ذو الطول الموجي nm810 & nm940 مبشراً بذلك بإمكانية استخدامه في مجال الكشف عن الأشعة تحت الحمراء بتكلفة تصنيع منخفضة ومقدرة على استخدامه في درجة حرارة الغرفة بدون تبريد .

كي يتم الحصول على استجابة جيدة صممت دائرة إلكترونية لها المقدرة على تحويل الكمية الفيزيائية المقاسة إلى خرج كهربائي (فولت) بالإضافة إلى حساسيتها العالية لأي تغيير في قيمة الدخل المقاس . ولأن المعاملات الفيزيائية المتحسس السلبي المصنوع لها دور كبير في تحديد استجابة المتحسس ، لذا هدف هذا البحث على تحديد المعاملات التي تصف سلوك المتحسسات المصنوعة . إن قيم معاملات المتحسسات الحرارية المصنوعة التي حصل عليها بواسطة التجربة العملية هي في المدى المقبول وكمثال لذلك ثابت المتحسس الحراري B لأحد المتحسسات الحرارية المصنوعة (المرموز له بالرمز diskC1) في طيات هذا البحث (يساوي K7704.33 بينما القيمة النموذجية هي بين 5000K – 8000K إن قيم المعاملات التي تسمى (Steinhart and Hart coefficients) والتي يرمز لها بـ b_0, b_1, b_2 وجد أنها تتطابق أو تختلف من متحسس لآخر طبقاً لظروف التصنيع . كمثال قيمة b_0 لمتحسسنا المصنوع (diskC1) هي 5.13×10^{-3} بينما القيمة النموذجية لهذا الثابت لمتحسس مثالي مقاومته 3000 ° عند درجة حرارة الغرفة (25 °C) هي $b_0 = 1.4 \times 10^{-3}$ ، نجد أن هاتين القيمتين قريبتان من بعضهما البعض ولكن قيمة b_1 (-2.62×10^{-4}) لمتحسسنا الحراري تختلف بشكل جوهري عن قيمة b_1 (2.37×10^{-4}) للمتحسس المثالي السابق في علامة السالب التي قد تكون نتجت بسبب طبيعة ونسب المواد الداخلة في التصنيع أو بسبب طريقة التصنيع نفسها .

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