



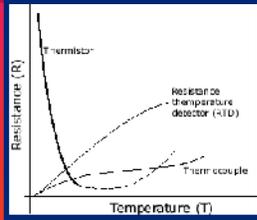
ELECTRICAL CHARACTERISTICS OF CuFe_2O_4 THICK FILM CERAMICS WITH DIFFERENT GLASS FRIT CONCENTRATIONS FIRED AT 1000 °C FOR NEGATIVE THERMAL COEFFICIENT (NTC) THERMISTOR



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INTRODUCTION

THERMISTOR → Thermally Sensitive Resistor.



NTC CHARACTERISTIC

APPLICATIONS



PRODUCT EXAMPLES



Incubator

Current limiter thermistor



Specialize Thermistor



Computer

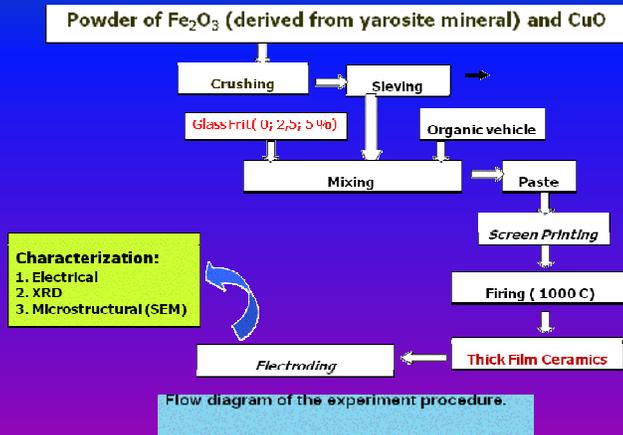
BACK GROUND

- Sectors: Biomedical, aerospace, instrumentation, communications, automotive and HVACR (Heating, Ventilation, Air conditioning and Refrigeration).
Application : Temperature sensor measurement, current limiter, circuit compensation,
- It is necessary to get capability in self producing thermistor by utilizing material abundant in Indonesia such as yarosite mineral (Fe_2O_3) : CuFe_2O_4 based-thick film for NTC Thermistor, with glass frit concentration (0; 2,5 ;5 weight %)
- The thermistor in the form of thick film is possible for miniaturization and integration . Advantages : more practical, profitable economically, need a few material, and fired at low temperature.

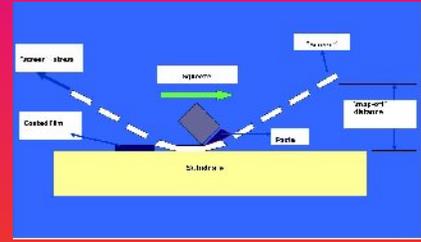
YAROSITE MINERAL



EXPERIMENT



SCREEN PRINTING

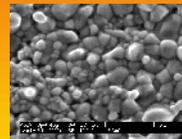


$$R = R_0 \cdot \text{Exp.}(B/T) \quad \ln R = B/T + \ln R_0$$

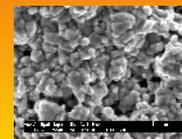
$$E_a = B \cdot k \quad \alpha = - B/T^2$$

RESULT

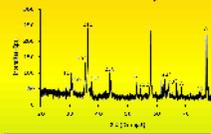
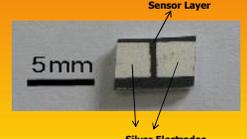
Thick Film (yarosite)



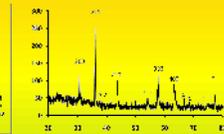
(without glass frit concentration)



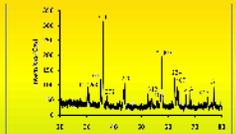
(with 2,5 % glass frit concentration)



(without glass frit concentration)



with 5,0 % glass frit concentration)



(with 2,5 % glass frit concentration)

Electrical Characteristics

The relation between \ln Electrical Resistivity and $1/T$ of CuFe_2O_4 based-thick film fired at 1000oC for 1 hr (with : 0; 2,5 , 5% glass frit concentration)

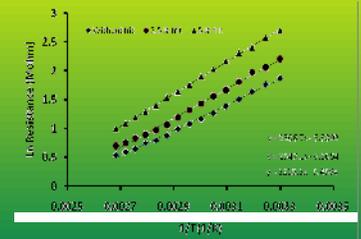


Table of electrical characteristics of CuFe_2O_4 thick film ceramics (with : 0; 2,5 , 5% glass frit concentration)

No.	Frit (%)	B (K)	Alfa (%/K)	R _{SR} (Mohm)
1.	0	2215	2,46	6,9
2.	2,5	2547	2,83	9,8
3.	5	2807	3,12	16,7

Market requirement for :
 B is ≥ 2000 oK
 α is ≥ 2.2 %/oK[7]
 ρ_{RT} = 10 ohm.cm -1 Mohm.cm [4].

CONCLUSION

- CuFe_2O_4 thick film ceramics utilizing Fe_2O_3 derived from yarosite mineral have been well fired at 1000°C for 1 hour. with : 0; 2,5 , 5% glass frit concentration.
- All of the thick films crystallize in tetragonal spinel.
- The SEM images showed that the effects of glass frit concentration make the grain size was smaller.
- Electrical data showed that the larger the glass frit concentration, the larger the : resistance, thermistor constant and sensitivity.
- The value of thermistor constant (B) = 2215-2807 K and room temperature resistance (R_{RT}) = 6,9-16,7 MOhm of the produced CuFe_2O_4 ceramics fitted market requirement.

ACKNOWLEDGMENT

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