Electrical Characteristics $CuFe_2O_4$ Ceramics With and Without Al_2O_3 for Negative Thermal Coefficient (NTC) Thermistor

Wiendartun[1], Dani Gustaman Syarif[2], Arief Permadi[1]

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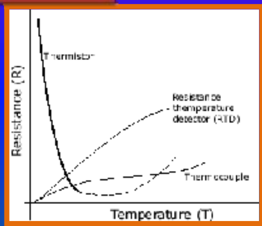
INTRODUCTION

THERMISTOR → Thermally Sensitive Resistor.

NTC CHARACTERISTIC



PRODUCT EXAMPLES

Current limiter thermistor

Specialize Thermistor

APPLICATIONS

Incubator

Computer

IMPORTANT ELECTRONIC COMPONENT

1. •Sectors : Biomedical, aerospace, instrumentation, communications, automotive and HVACR (Heating, Ventilation, Air conditioning and Refrigeration).
2. • Application: Temperature sensor, electric current limiter, flowrate meter and pressure sensor.
3. • Most, thermistors are produced from spinel ceramics based on transition metal oxides forming general formula AB_2O_4
4. • Predicted that the Al_2O_3 addition can improve the characteristics of the $CuFe_2O_4$ ceramic for NTC thermistors.

EXPERIMENT

CuO, Fe_3O_4, SiO_2 → MIXING → CALCINATION (800 °C/2 h) → CRUSHING → PRESSING (3, 9 ton/Cm²) → SINTERING (1100 °C/2 h) → CHARACTERIZATION

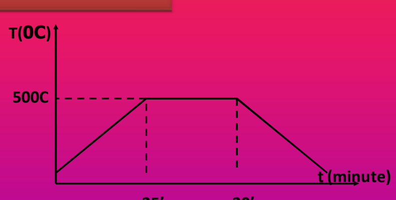
CHARACTERIZATION
- XRD
- Electrical
- Microstructural

Sintering Furnace

Optical Microscope

XRD

HEAT TREATMENT



SAMPLE COMPOSITION IN MOLE % TABLE

No.	CuO	Fe_2O_3	Al_2O_3
1.	40	60	0
2.	40	59	1
3.	40	55	5

ELECTRICAL CHARACTERISTIC

- $R = R_0 . \mathrm{Exp}.(B/T)$
- $Ea = B.k$
- $\alpha = -B/T^2$

R = Thermistor resistance

R_0 = Resistance at the infinite temperature

B = Thermistor constant

T = Temperature of thermistor

Ea = Activation energy

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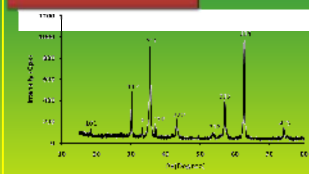
RESULT (XRD)



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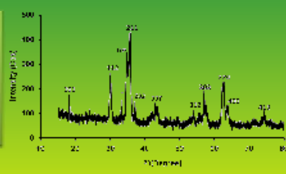
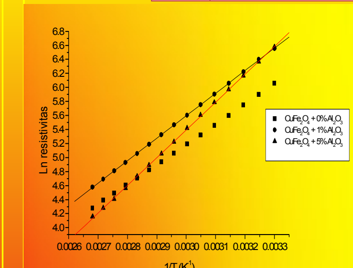


RESULT (ELECTRICAL CHARACTERISTIC)

No.	Additive of Al_2O_3 (mol %)	B (°K)	α (%/°K)
1.	0	2862	3.22
2.	1	3208	3.61
3.	5	3958	4.46



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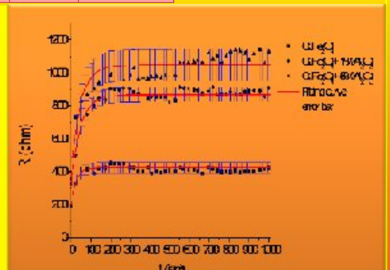

Electrical resistance as function of time as the result of ageing test

CONCLUSION

- All $CuFe_2O_4$ base-ceramic crystallized in tetragonal structure.
- Thermistor constant (B) and sensitivity (a) of the $CuFe_2O_4$ base- ceramics increase with the increase of Al_2O_3 concentration.
- This means that the additionof Al_2O_3 can be used as a controlling parameter.
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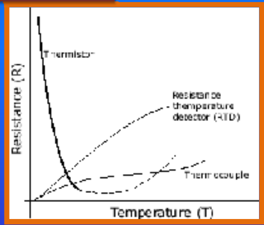

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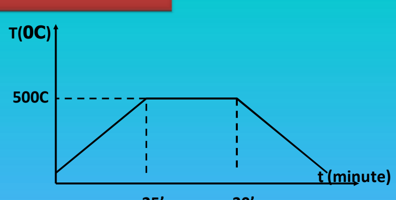

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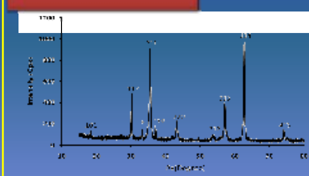

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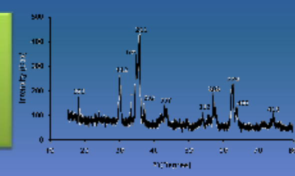

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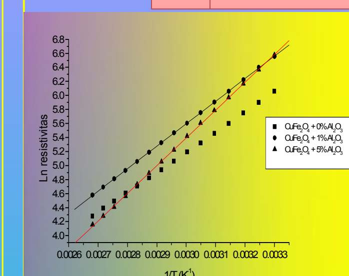

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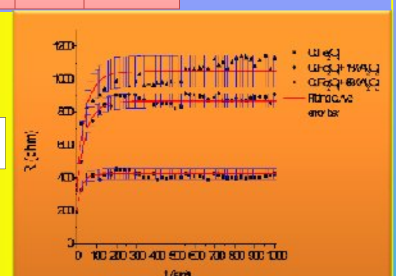

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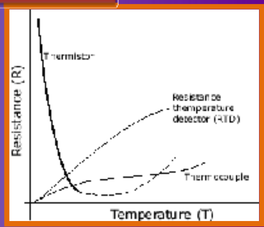

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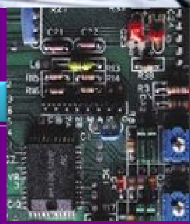

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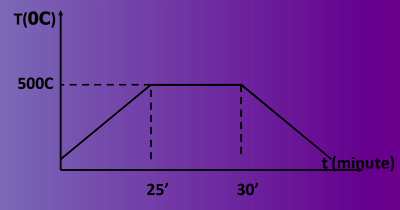

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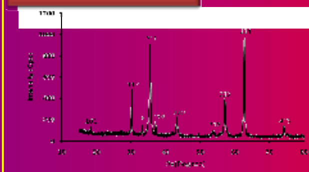

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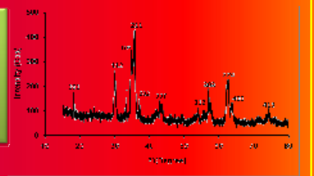

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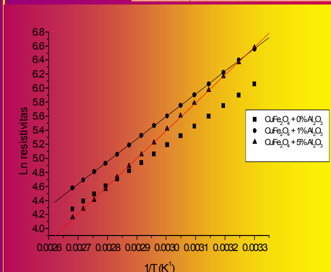

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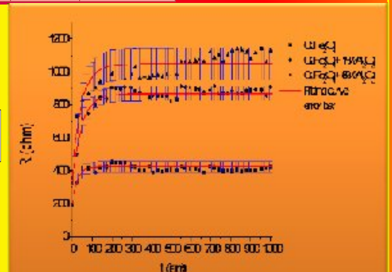
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