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Electrical Characteristics of CuO Added-$ZnFe_2O_4$ Ceramic Semiconductor in Air and Ethanol Gas Atmosphere

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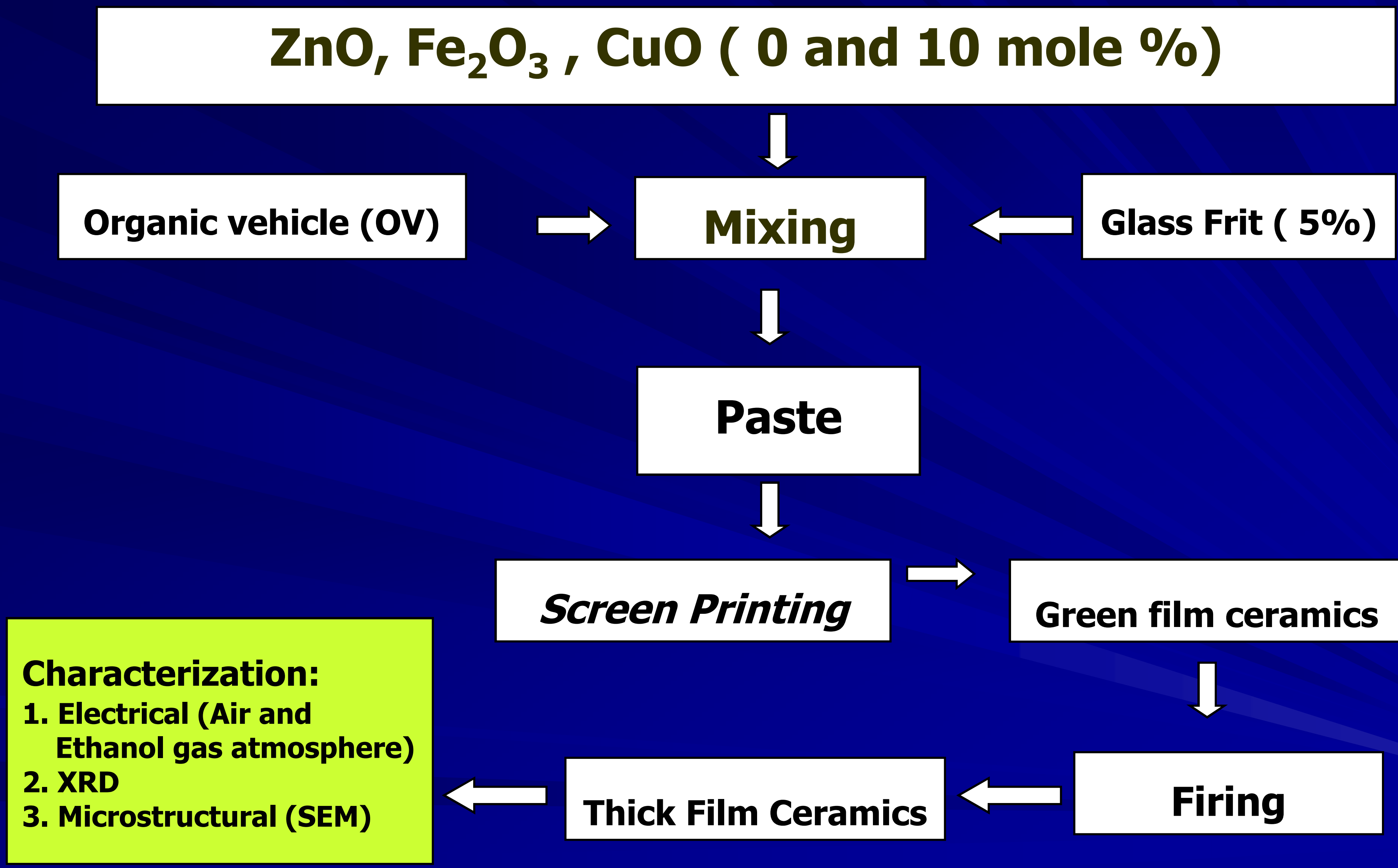
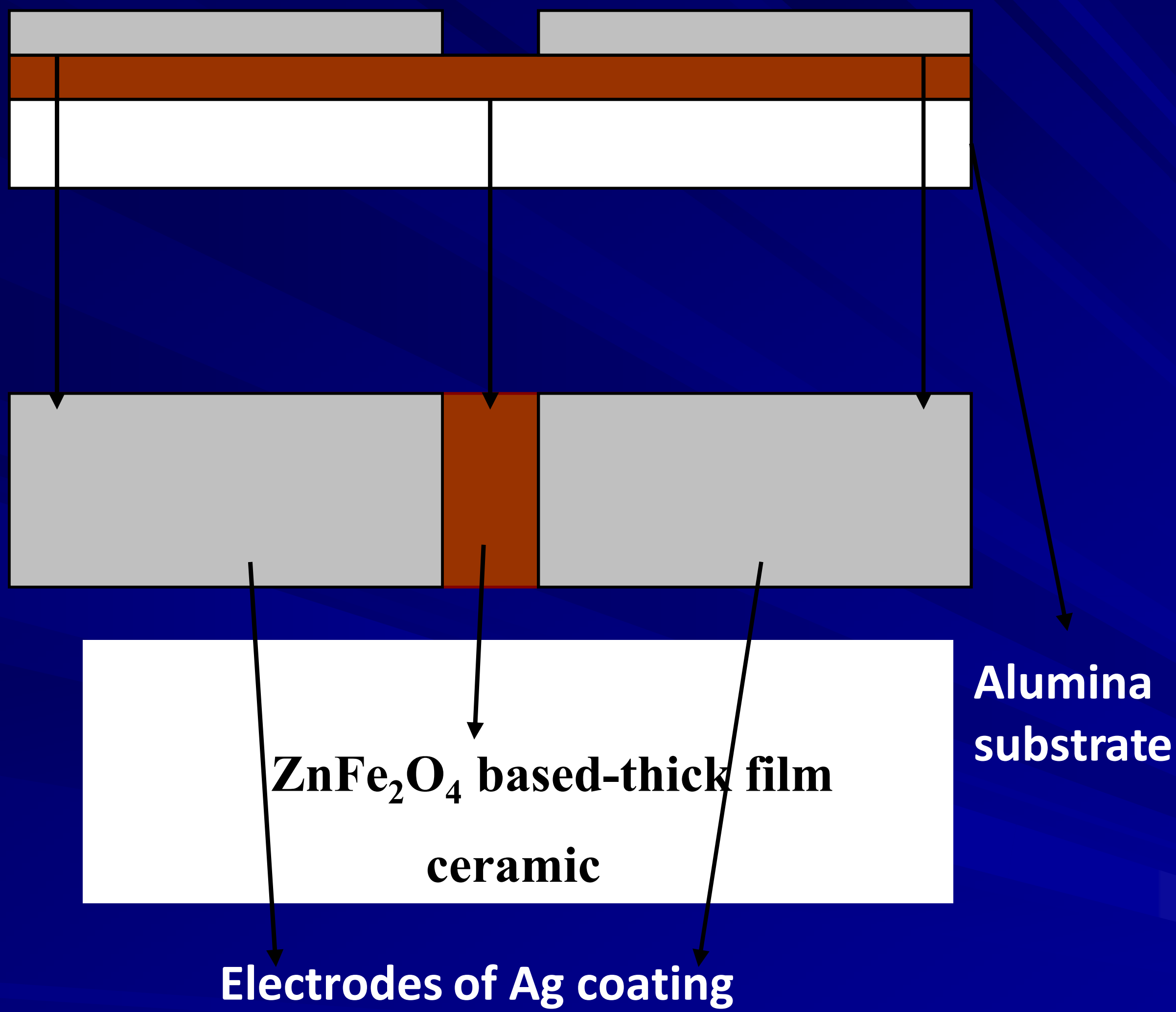
INTRODUCTION

- **In modern life people need many sophisticated products for daily life such as food industry, environment and health , one of the products required is gas sensor.**
- **It is necessary to get capability in self producing gas sensor by utilizing mineral containing Zn and Fe abundant in Indonesia. → $ZnFe_2O_4$ based-thick film ceramic for ethanol gas sensor with low working temperature.**
- **A preliminary study of producing thick film ceramic based on $ZnFe_2O_4$ for ethanol gas sensor.**
- **Theoretically, the addition of CuO may change the microstructure of the $ZnFe_2O_4$, so the $ZnFe_2O_4$ thick film ceramic with different microstructure may have different electrical characteristics, then may change the electrical characteristics of the $ZnFe_2O_4$ thick film ceramic.**
- **The aim of this work is to know the effect of CuO addition on electrical characteristics of the $ZnFe_2O_4$ thick film ceramics in air and ethanol gas.**

EXPERIMENT :

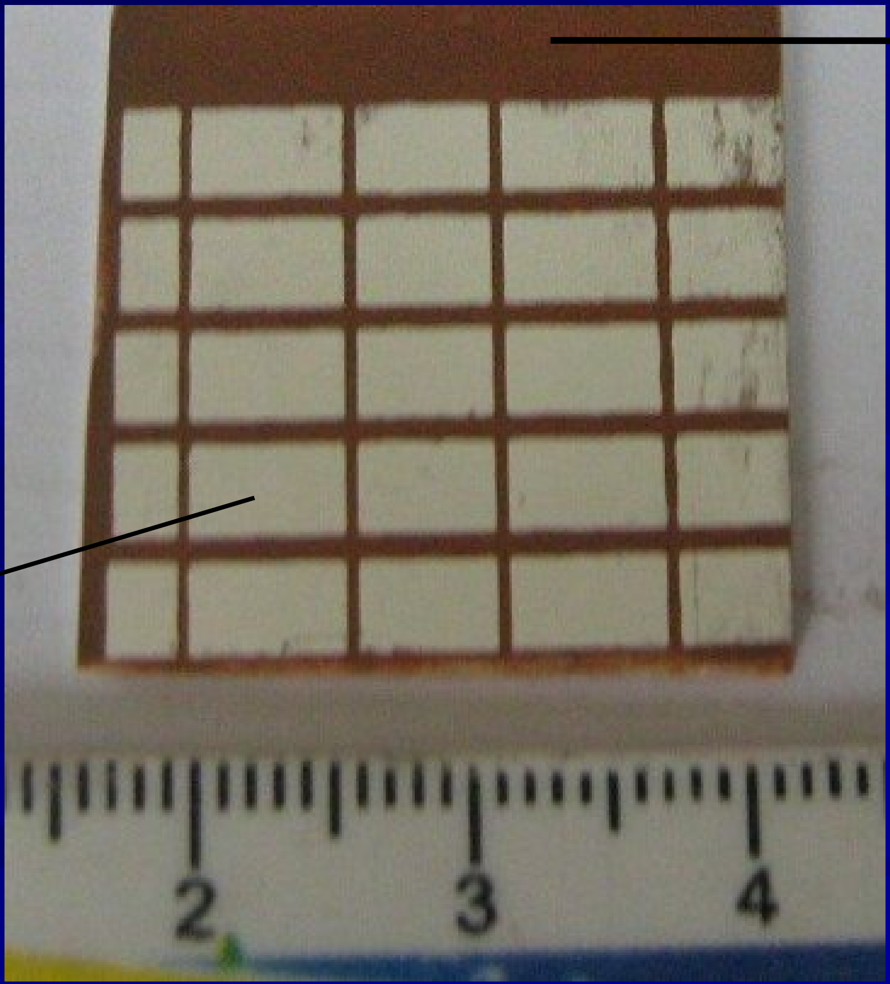


Flow diagram of the experiment procedure



A schematic *view* of
a thick film ceramic sensor

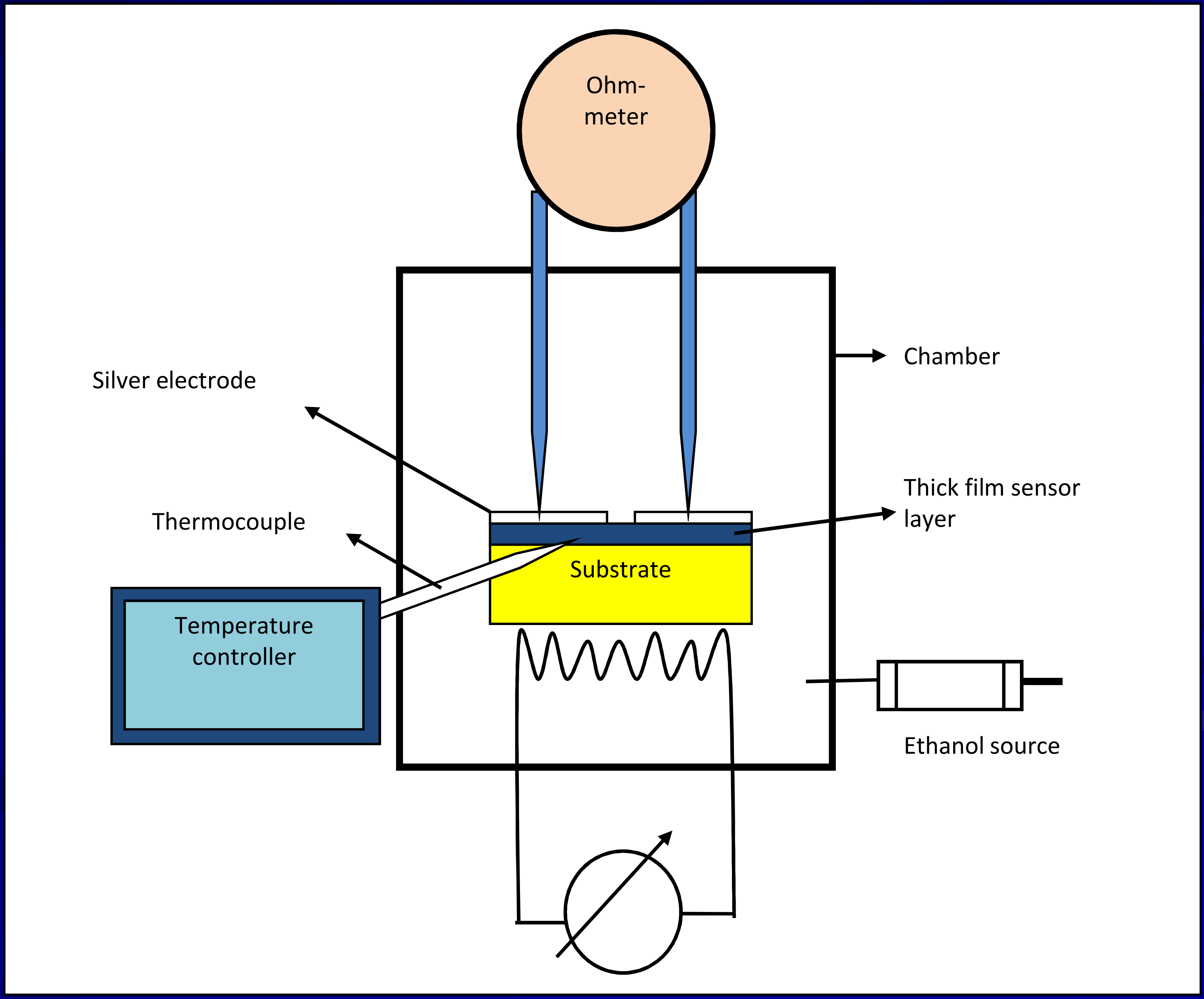
Appearance of the $ZnFe_2O_4$ thick film ceramic before cutting.



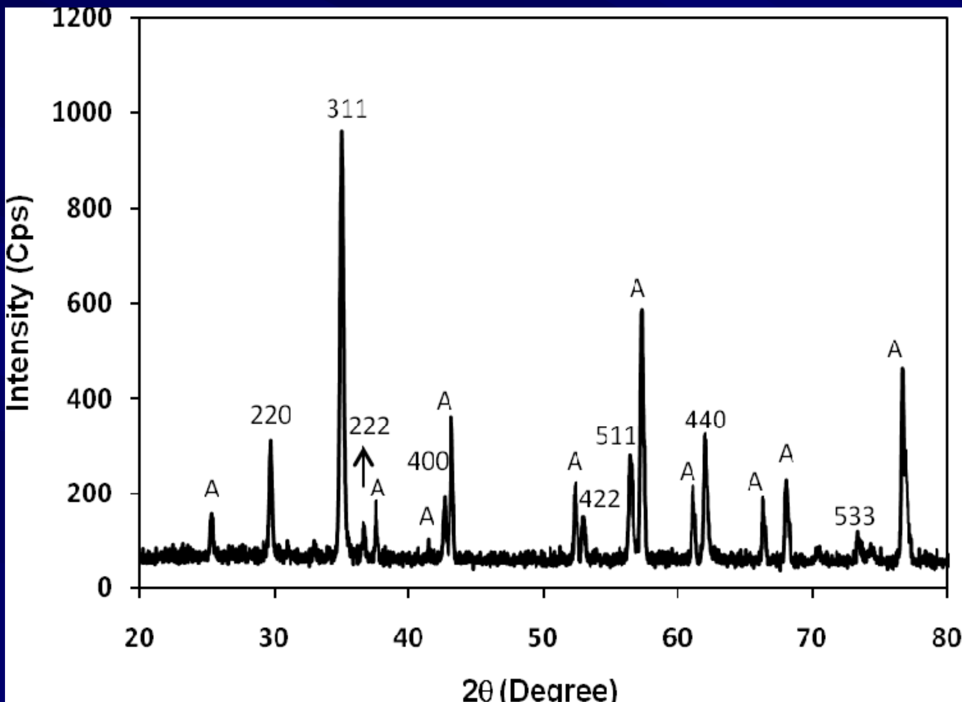
Thick film ceramic

Silver electrode

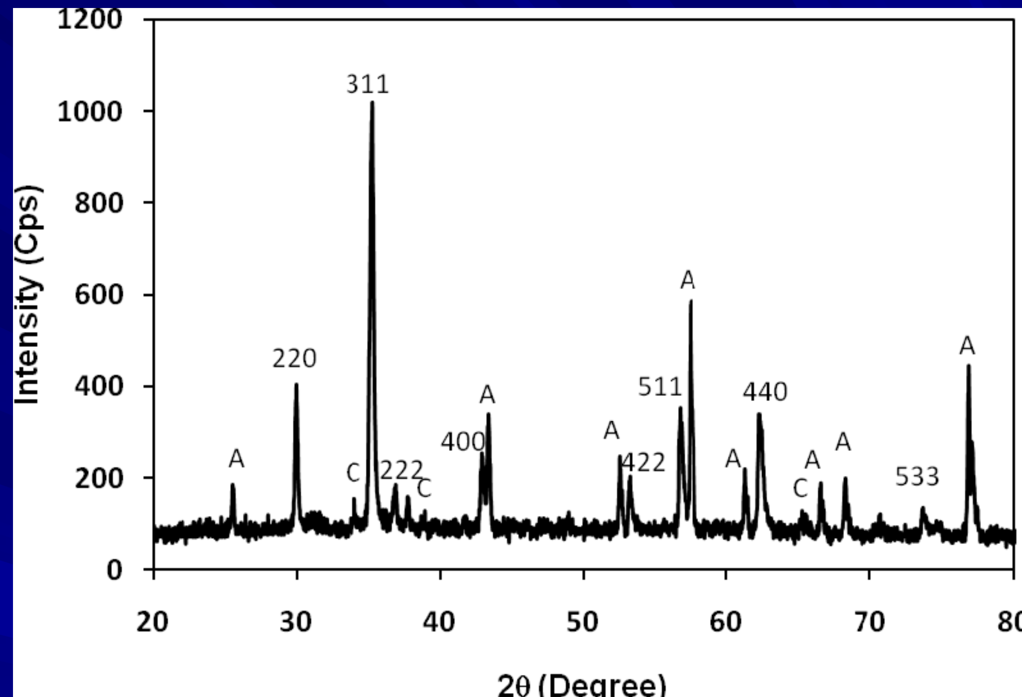
Schematic *figure* of electrical characterization.



RESULT (XRD)



Diffraction profile of $ZnFe_2O_4$ thick film.



Diffraction profile of CuO added-$ZnFe_2O_4$ thick film. C is peak from CuO. A is from substrate.

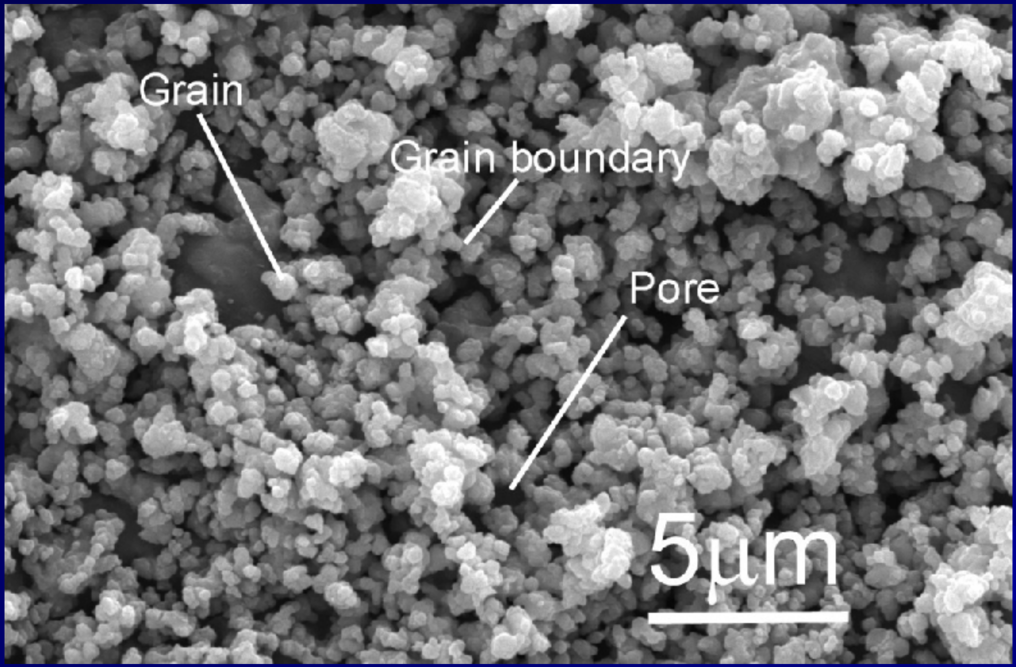
XRD profile of $ZnFe_2O_4$ based-thick film

RESULT (XRD)

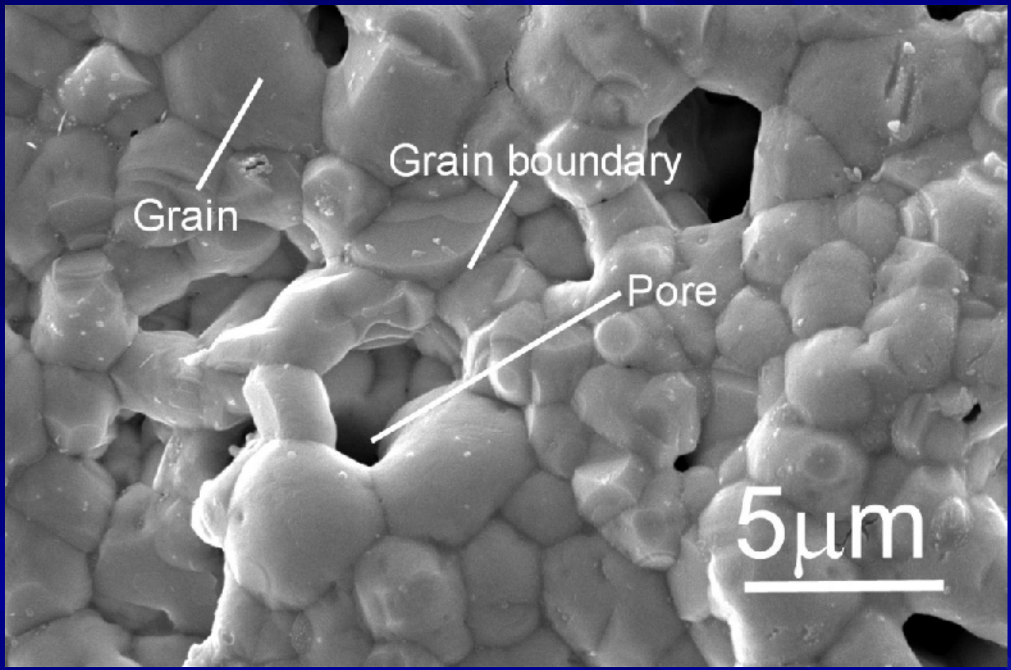
Lattice constant of $ZnFe_2O_4$ and CuO added- $ZnFe_2O_4$ thick film ceramics.

No.	Concentration of CuO (%)	Lattice constant (Angstrom)
1	**0**	**8.461± 0.078**
2	10	**8.434± 0.018**

RESULTS (Microstructure)



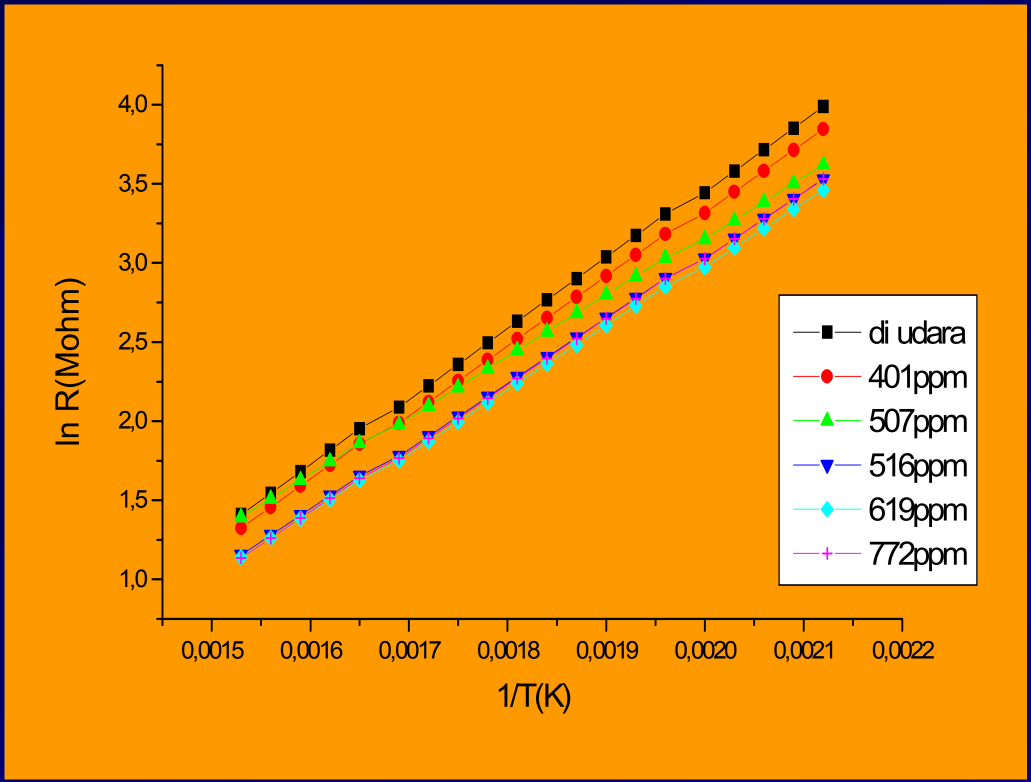
Microstructure of $ZnFe_2O_4$ thick film.



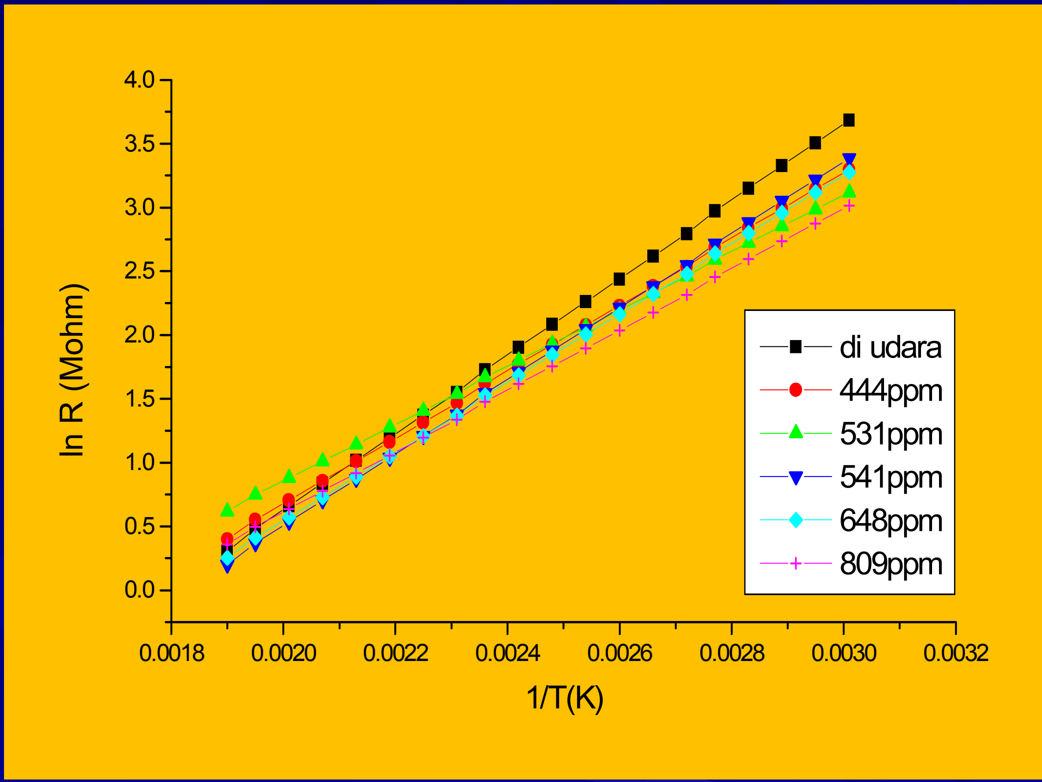
Microstructure of $ZnFe_2O_4$:CuO 10 mole % thick film.

Microstructure of the $ZnFe_2O_4$ thick film

RESULTS (Electrical Characteristics)

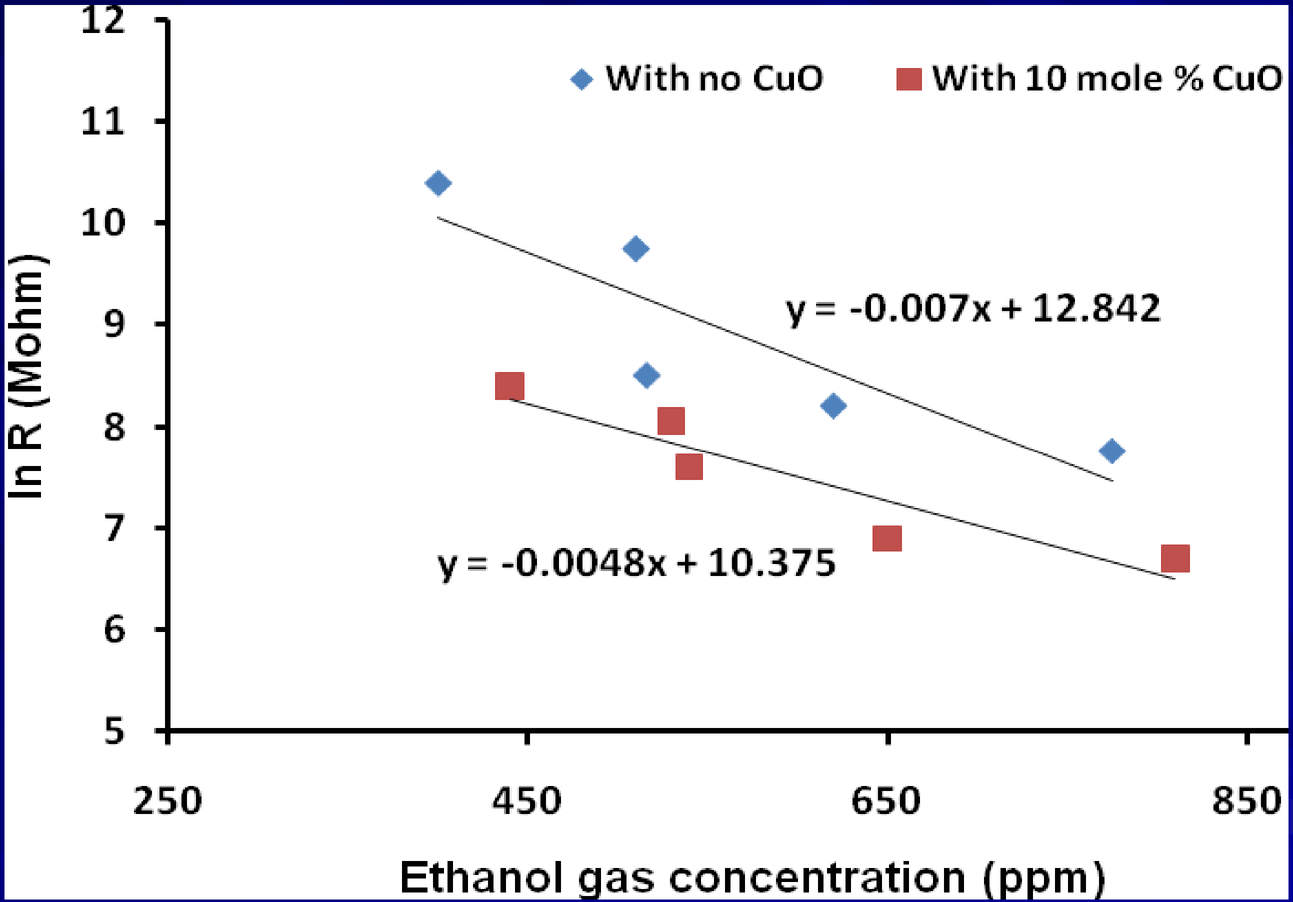


In R versus 1/T for $ZnFe_2O_4$ thick film ceramic in air and ethanol gas.



In R versus 1/T for CuO added-$ZnFe_2O_4$ thick film ceramic in air and ethanol gas.

RESULTS
(Electrical Characteristics)



Resistance (R) as a function of ethanol gas concentration of $ZnFe_2O_4$ thick film ceramic for measurement temperature of 290oC and of CuO added-$ZnFe_2O_4$ thick film ceramic for measurement temperature of 120oC.

CONCLUSIONS

- **Thick film ceramics of $ZnFe_2O_4$ and CuO added-$ZnFe_2O_4$ had been well produced at firing temperature of 1000°C.**
- **All of the thick films crystallizes in spinel cubic.**
- **The addition of 10 mole % CuO : decreases the electrical resistance, decreases the working temperature and decreases the sensitivity of the $ZnFe_2O_4$ thick film ceramic, because the addition of 10 mole % CuO changes the microstructure resulting in large grains.**
- **The produced thick film ceramics have semiconductor characteristic where the resistance decreases with the increase of temperature.**
- **The resistance of the films measured in ethanol gas is lower than that of the film measured in air.**
- **The resistance of the film decreases with the increase of ethanol gas concentration.**

THANK YOU

ACKNOWLEGMENT

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