Electrical Characteristic of Fe_2O_3 Thick Film Ceramics Made from Local Mineral in Air and Ethanol Atmosphere

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ABSTRACT. In order to find possibility to utilize local mineral for high value products, fabrication of Fe_2O_3 thick film ceramics from local mineral of yarosite has been carried out and characteristics especially electrical characteristics of the thick film ceramics have been studied. Powder Fe_2O_3 was derived from yarosite using precipitation method. The nano powder of Fe_2O_3 was mixed with organic vehicle (OV) consists of alpha terpineol and ethyl cellulose to form a paste. The paste was screen printed on alumina substrates using screen sizes of 183 mesh. The green thick films were fired at temperature of 950°C for 90 minutes. The fired film was analyzed using an x-ray diffractometer (XRD) to know its crystal structure and a Scanning Electron Microscope (SEM) to know its morphology. Electrical resistance of the thick films was measured at various temperatures in air and air containing ethanol gas.

Key words: *Ceramic, Fe_2O_3, Thick film, ethanol sensor*

1. INTRODUCTION

In order to find possibility to utilize local mineral for high value products, study of fabrication of a special product such as gas sensor has to be carried out. Here, fabrication of Fe_2O_3 thick film ceramics from local mineral of yarosite has been done and their electrical characteristics has been studied.

2. MATERIALS AND METHOD

Powder Fe_2O_3 was derived from yarosite using precipitation method. Mineral of yarosite was dissolved in HCl. Certain amount of NH4OH was added into the solution until forming precipitation. The precipitate was dried and calcined at 700°C for 2 hours. The powder was analyzed using an x-ray diffractometer (XRD). The nano powder of Fe_2O_3 was mixed with organic vehicle (OV) consists of alpha terpineol and 10 weight % ethyl cellulose to form a paste. The paste was screen printed on alumina substrates using screen sizes of 183 mesh. The green thick films were fired at temperature of 950°C for 90 minutes. The fired film was analyzed using XRD to know its crystal structure and a Scanning Electron Microscope (SEM) to know its morphology. Electrical resistance of the thick films was measured at various temperatures in air and air containing ethanol gas.

3. RESULTS AND DISCUSSION

Visual appearance of Fe_2O_3 powder derived from yarosite is shown in Figure 1. The XRD profile of the Fe_2O_3 powder is shown in Figure 3. Particle size is 42 nm as calculated using Debye Scherrer method [1,2].

Visual appearance of a fired thick film was shown in Figure 2. The film looks good without any crack. The XRD data showed that the thick films had phase of hematite as shown in Figure 3. The SEM data showed that the thick films were porous with relatively small grain size as shown in Figure 4. Electrical resistance of the ceramics decreases following the increase of temperature indicating a semiconducting property. The property is extrinsic property of Fe_2O_3 [3]. The electrical resistance of the thick films in air was higher than that of the thick films in air containing ethanol gas as shown in Figure 5. Ethanol gas acts as a electron donor for the Fe_2O_3 ceramics as found in another ceramic that has been applied as an ethanol sensor [4]. This results showed that the thick film ceramics produced here may be applied for ethanol sensor.

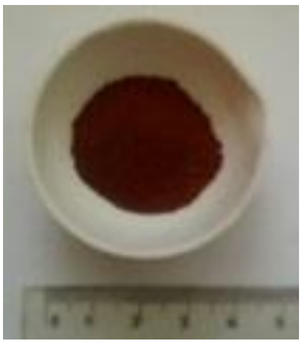

Figure 1. Visual appearance of Fe_2O_3 powder.

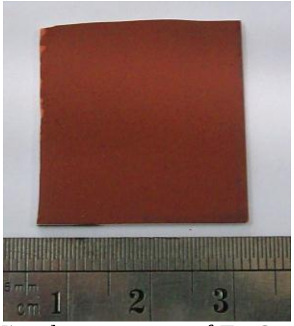

Figure 2. Visual appearance of Fe_2O_3 thick film.

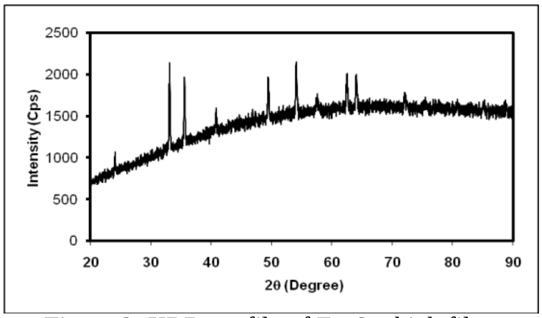

Figure 3. XRD profile of Fe_2O_3 thick film.

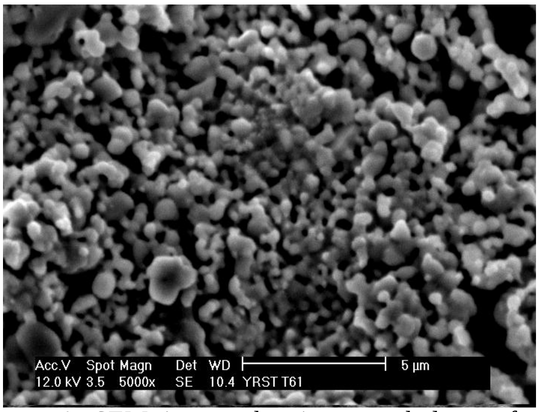

Figure 4. SEM image showing morphology of the Fe_2O_3 Thick film.

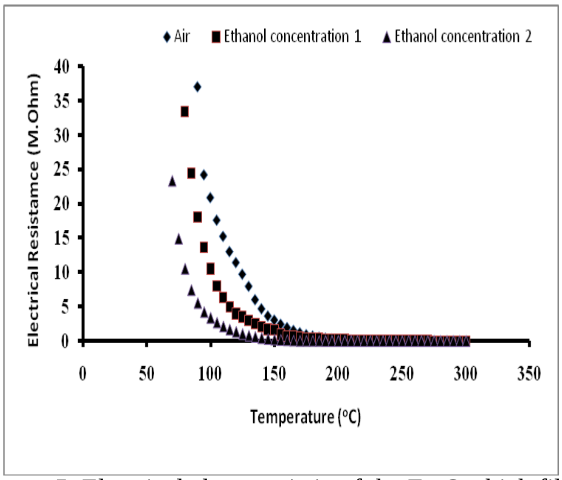

Figure 5. Electrical characteristic of the Fe_2O_3 thick film

4. CONCLUSION

Thick film ceramics of Fe_2O_3 has been successfully fabricated from local mineral of yarosite. Electrical resistance of the ceramics in ethanol atmosphere was lower than that in air. The ceramics have potentiality to be applied as ethanol sensor.

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