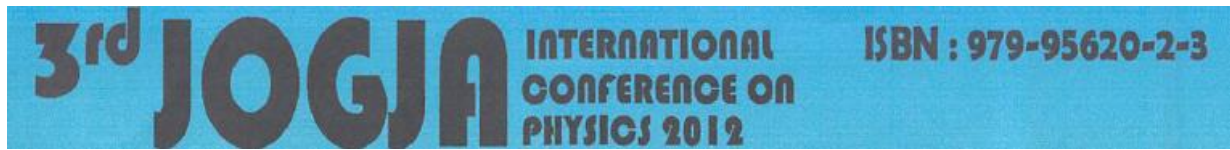


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The Effect of MnO₂ addition on The Electrical Characteristics of Fe₂TiO₅ Ceramics for NTC Thermistors

**3rd Jogja International Conference on Physics 2012
18-19 September 2012
Gajah Mada University, Yogyakarta, Indonesia**

Wiendartun, Risdiana, **Fitrilawati**, Dani Gustaman Syarif,
R.E. Siregar

3rd JOGJA INTERNATIONAL CONFERENCE ON PHYSICS 2012

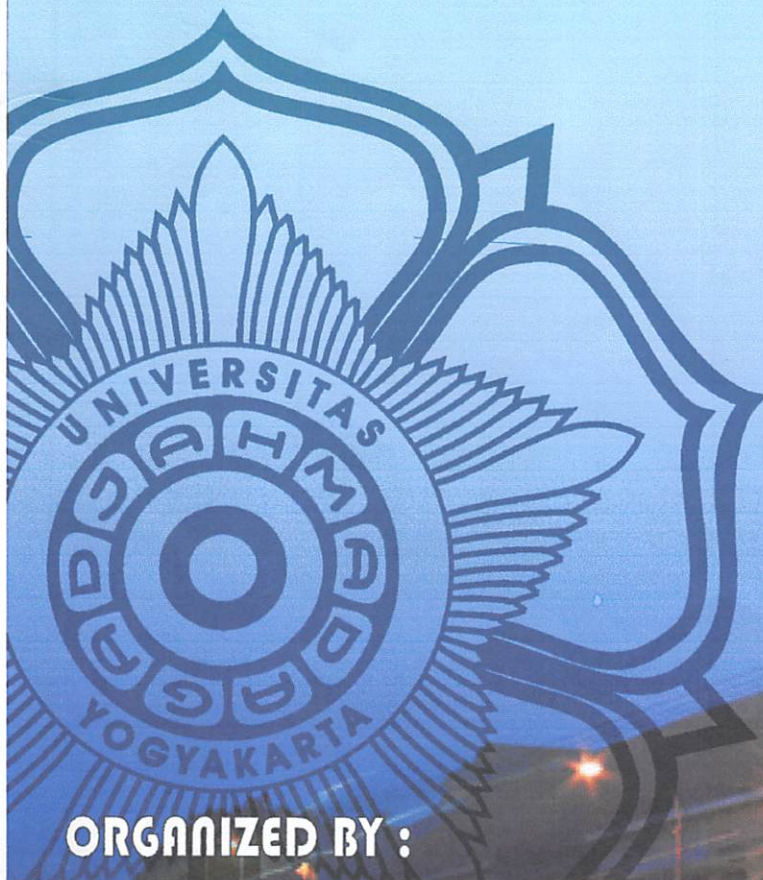
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UNIVERSITAS GADJAH MADA**

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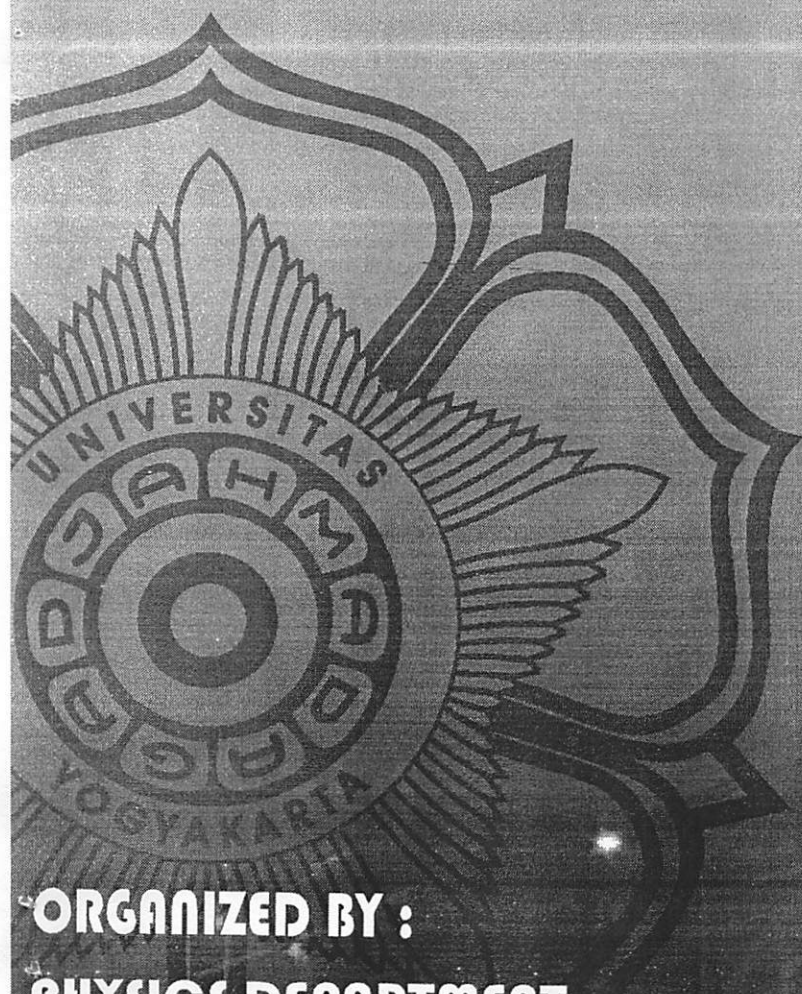
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Foreword

Welcome to the International Conference on Physics 2012, this conference is the continuation of the previous Jogja International Physics Conference 2007 and the Jogja Regional Physics Conference 2005. This conference is organized by the Physics Department Universitas Gadjah Mada to enhance networking, cooperation, the development of research, and education in physics. We are very happy for the enthusiastic participations on this conference. We welcome you also to Jogjakarta, the most beautiful cultural based city in Indonesia.

The Department of Physics would like to appreciate and recognize all of the keynote speakers in this conference, Prof. Dr. Shoichi Kai (Kyushu University), Prof. Dr. Makoto Notomi (Waseda University), Dr Isao Watanabe (RIKEN, Japan), Prof. Frans. J.M.Harren (Radboud Nijmegen University), Dr. Hiroataka Sato (Nanyang Technological University), Dr. Nurul Taufiqurrahman (Chairman Indonesian Nanotechnology Society), and Prof. Dr. Kamsul Abraha (Universitas Gadjah Mada University).

On behalf of the Physics Department I would like to express sincere gratitude to the Organizing Committee members of the conference, all Laboratories, and Study Programs for their hospitalities and supports. Last but not least I would to give my thanks to the Faculty of Mathematics and Natural Sciences Universitas Gadjah Mada for their continuous supports. I hope this conference will give significant contributions to physics development in Indonesia.

With sincere gratitude

Head of Physics Department

Gadjah Mada University, Yogyakarta Indonesia

Dr.-Ing. Ari Setiawan

Foreword

International Conference on Physics 2012 is the third physics conference organized by department of Physics, Gadjah Mada University. The conference is intended for physicist-research sharing forum all over the world to increase their interaction toward enhancing the progress in the field of physics.

This year there are six papers in the plenary session, which are presented by six invited speakers. The committee also received 92 papers. The papers consist of Condensed Matter (34 papers), Geophysics, Atomic and Molecular Physics, and Interdisciplinary Physics (18 papers), Computational and Theoretical Physics (18 papers), Instrumentation and Applied Physics (15 papers), and posters (7 papers). There will be five different concurrent sessions can be attended at any time during the conference.

The committee has done an admirable job of arranging the program for the benefit of participants. The committee hopes that this conference can enrich, enhance the physics knowledge, and serves as a forum for individual to meet and discuss physics current issue.

Dr. Edi Suharyadi

Chair person

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The Effect of MnO₂ addition on The Electrical Characteristics of Fe₂TiO₅ Ceramics Sintered at 1200°C for NTC Thermistors

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Abstract.

The effect of MnO₂ addition on the characteristics of Fe₂TiO₅ ceramics for NTC thermistors has been studied in order to produce high performance thermistor. Powder of MnO₂ derived from commercial with various concentration of : 0, 0.5 and 1.0 mole % were mixed homogeneously in appropriate proportions to produce Fe₂TiO₅ based ceramics. The mixed powders were pressed with pressure of 4 ton/cm² to form pellets. The green pellets were sintered at 1200°C for 2 hours in furnace air. Electrical characterizations of the pellets were done by measuring electrical resistivity (ρ_{RT}) of the sintered ceramics at various temperatures from 55°C to 310°C. The pellets were also subjected to XRD and SEM analyses in order to know crystal structure and microstructure of the pellets. The XRD data showed that the dominant phase of the all ceramics was Fe₂TiO₅. According to the electrical data, it was found that adding MnO₂ to the Fe₂TiO₅ increased the thermistor constant (B) and the electrical resistance of the ceramics decreased with the increase of the MnO₂ concentration. Thermistor constant (B) of the ceramics was relatively big of 5146.4°K to 6612.4°K. The value of B indicated that adding MnO₂ to the Fe₂TiO₅ will increase performance of NTC thermistor.

Key words: Ceramic, Thermistor, NTC, Fe₂TiO₅, MnO₂.

I. Introduction

It has been known that NTC thermistor could be applied in many applications such as temperature sensor, electric current limiter, and flow rate meter and pressure sensor [1]. The NTC thermistor is generally made of ceramic having structure of spinel of AB₂O₄, where A is the ion occupies tetrahedral position and B is the ion occupies octahedral position [2-6]. Although a report on NTC thermistor for higher temperature is available [5], however, the publication of the NTC thermistor with higher operation temperature made of Fe₂TiO₅ is not available so far. Compared to the traditional NTC thermistor material, Fe₂TiO₅ has higher bandgap so suitable for higher temperature operation. It is known that the traditional thermistor working temperature is up to 100°C [4]. In this work, the possibility of the application of the Fe₂TiO₅ ceramic for NTC thermistor with higher working temperature was studied.

Doping may be done to improve the performance of the NTC thermistor. The addition of dopant into the Fe₂TiO₅ ceramic may increase the

thermistor constant which then improves the performance of the thermistor. Many efforts have been being performed in order to improve the characteristic of the spinel NTC thermistor. Fe₂TiO₅ ceramic is one of some ceramics that can be applied for NTC thermistor. The thermistor may be produced in the form of pellet, thick or thin film. Here, the object of study is the pellet thermistor form. In this work, a study on the effect of MnO₂ addition on the electrical characteristics based on Fe₂TiO₅ ceramics for NTC thermistor was performed.

II. Methodology

Powders of Fe₂O₃, TiO₂, and MnO₂ were weighed in appropriate proportions to fabricate MnO₂ added-Fe₂TiO₅ ceramics and mechanically mixed. Powder of MnO₂ derived from commercial with various concentration of : 0, 0.5 and 1.0 mole % were mixed homogeneously in appropriate proportions to produce Fe₂TiO₅ based ceramics. The mixed powders were pressed with pressure of 4