10th Eco-Energy and Materials Science and Engineering Symposium


On December 5-8, 2012
Sunee grand hotel,
Ubon-ratchathani

Organized by

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PREFACE:
Message from the President of
Rajamangala University of Technology Thanyaburi

Rajamangala University of Technology Thanyaburi (RMUTT), in conjunction with Kyoto University, is please to host the 10th Eco-Energy and Materials Science and Engineering Symposium (10th EMSES). This international conference is not only giving an opportunity for Thai and foreign researchers to present and discussion their research works and update their expertise but also to initially stimulate the development of research works on eco-energy and materials science and engineering. Our program consists of six research tasks: (1) Energy Technology, (2) Environmental and Social Impact, (3) Nanotechnology and Materials Science, (4) Energy Economics and Management, (5) New Energy Technology and (6) Nuclear Technology.

I would like to take this opportunity to express our sincere gratitude to our two distinguished Plenary Speakers for kindly accepting our invitation. I deeply appreciative of the very strong support given by Kyoto University. Thanks to the tireless works of the Organizing Committee, the Technical Program Committee, the invited speakers and paper and poster contributors, and excellent program been assembled to cover a broad spectrum of interesting topic.

We warmly welcome you to the 10th EMSES on December 5-8, 2012, Ubon Ratchathani, Thailand.

Numyoot SONGTHANAPITAK, Ph.D.
President of Rajamangala University of Technology Thanyaburi
and Conference Chairman of 10th EMSES 2012
It is my great pleasure to have the 10th Eco-Energy and Materials Science and Engineering Symposium (EMSES) with Rajamangala University of Technology Thanyaburi (RMUTT) under the long-term collaboration between RMUTT and Kyoto University. The 1st EMSES was held in 2001 in Thailand and the symposium has been expanded in its scientific contents as well as the academic network. I believe that the 10th EMSES gives a good opportunity to all participants to exchange their knowledge and idea to realize eco-friendly energy system in society. I would like to express my welcome to all participants and sincere thanks to the 10th EMSES organizing committee and all supporting organizations to make us having this symposium. I hope that the symposium will be successful and lead to further progress in energy science and technology and also in friendships of participants.

Professor Yukio Ogata, Ph.D.
Director of Institute of Advanced Energy, Kyoto University
PREFACE:
Message from the Former Dean of
Graduate School of Energy Science, Kyoto University
Program Leader,
Global COE “Energy Science in the Age of Global Warming”

I want to express my hearty welcome to all participants of Eco-Energy and Materials Science and Engineering Symposium (10th EMSES). This symposium is aiming the realization of importance of energy and materials technology through the academic, science and technology network among the world communities. The symposium gives an opportunity for researchers to discuss their research works and also to initially stimulate the development of research works on eco-energy and materials science and engineering. Once the cooperation among researchers has been created, the further cooperation work will be developed.

I would like also extend my sincere thanks to all who made the meeting possible, including the 10th EMSES organizers, the SEE forum committee members, and the Japanese Government, JSPS, for their kind support. I am looking forward to seeing you in Ubon Ratchathani, Thailand.

Professor Takeshi YAO, Ph.D.
Former Dean of Graduate School of Energy Science, Kyoto University
and Program Leader, Global COE “Energy Science in the Age of Global Warming”
Rajamangala University of Technology Thanyaburi (RMUTT), in conjunction with Kyoto University, is pleased to host the 10th Eco-Energy and Materials Science and Engineering Symposium (10th EMSES).

RMUTT has a major mission on encouraging and supporting all areas of research. One of the key reasons is to assist in developing capability in science and technology in order to cope with recent rapid change in this field. We have jointly set up an academic symposium on the 10th EMSES with the perception on the significance of exchanging knowledge and research experiences between researcher in the field of energy, materials technology and environmental science. This symposium is not only giving an opportunity for Thai and foreign researcher to present and discussion their research works and update their expertise but also to initially stimulate the development of research works on eco-energy and materials science and engineering. Once the cooperation among researchers has been created, the closer future cooperation incorporate with joint-research works will be developed. Thus, to support the aforesaid role, the symposium working committee would like to invite you to participate in this academic symposium.

I would like to express our sincere thanks to the organizing committee, participants and contributors for your kind corporation to this symposium. I wish this symposium proceeding will be a useful reference for future scientific research development.

Sommai PIVSA-ART, Ph.D.
Dean of Faculty of Engineering, RMUTT
Director of CoE on Sustainable Energy System (Thai-Japan)
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Hydrothermal Preparation and Photocatalytic Activity of Nanosheets from Natural Ilmenite Mineral

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Abstract—Nanosheets were synthesized by a simple hydrothermal method using low-cost natural ilmenite mineral as the starting materials at temperature of 120 °C for 24 h. The shape and size of the prepared sample were characterized by scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The prepared sample showed flower-like morphology with diameter of 3-5 μm. The nanosheets structure was slightly curved and approximately 100 nm to 2 μm in width and several nanometers in thickness. The as-synthesized nanosheets showed the highest photocatalytic activity than that of commercial nanoparticles TiO₂(P-25, JRC-01, JRC-03). This synthetic method provides a simple route for the nanosheets preparation from a low-cost natural mineral.

Keywords—Nanosheets; Ilmenite mineral; Hydrothermal; Titanate; TiO₂

1. INTRODUCTION

The titania materials (TiO₂) and TiO₂-related materials are important for utilizing solar energy and environmental purification. TiO₂ has been widely used for various applications such as a semiconductor in dye-sensitized solar cell, water treatment materials, catalysts and gas sensors [1-6]. The synthesis and characterization of nanostructured materials (nanotubes, nanorods, nanowires, and nanosheet) have been received considerably attended due to their unique properties and novel applications. Several methods were employed in the preparation of the TiO₂-derived nanomaterials such as sol-gel, electrodeposition, electrospinning, hydrogen treatment, anodic porous alumina templating, carbon nanotube inner templating, supramolecular assembly templating, anodic oxidation of a titanium sheet, and hydrothermal NaOH (aq.) treatment. Ilmenite (FeTiO₃) is a natural source of low titanium content TiO₂ (usually approximately 50-60 %) [7-26]. In our previous works, the hydrothermal method was selected to synthesize nanosheets from titanium butoxide [7] and nanofibers from ilmenite mineral [9].

In this study, the nanosheets were simply prepared by hydrothermal method using inexpensive natural ilmenite mineral as the starting material.

2. EXPERIMENTAL

2.1 Synthesis

Titanate nanosheets were synthesized by hydrothermal method using a natural ilmenite mineral (Sakorn Minerals Co., Ltd., Thailand) as the starting material. These materials are made from 16 g of the black granule of the ilmenite mineral (used without purification) are placed in a teflon-lined stainless steel autoclave (Fig. 1). To the autoclave was then added 2000 mL of 5 M NaOH (aq.), followed by heating at 120 °C for 24 h with stirring. After the autoclave was allowed to cool to room temperature, the resulting product was washed several times with an 0.1 M HCl (aq.) solution and then several times with distilled water, followed by drying with hot air at 100 °C for 12 h. The experimental procedure is schematically shown in Fig. 2.

2.2 Characterization

The shape and size of the as-synthesized sample were analyzed by scanning electron microscopy (SEM, JEM-6510, JEOL) with accelerating voltages of 5-20 kV and transmission electron microscopy (TEM, JEOL JEM-2010 Electron Microscope).

2.3. Photocatalytic activity measurement

Photocatalytic activity was measured through the concentration of I₂ that generated from photo oxidation reaction of I which transformed into I₂ in excess of I condition [5, 22] following Eqs. (1) and (2).

\[ 2I^- \rightarrow I_2 + 2e^- \quad (1) \]

\[ I_2 + I^- \rightarrow I_3^- \quad (2) \]
The 50 mg of TiO₂ powders and potassium iodide solution were filled into a cylindrical vessel. After that, it was placed on obscure condition, and 15 W of UV light was illuminated with stirring condition at room temperature for 1 h then the solution was separated by centrifuge method and it was diluted for 10 times order to measured of ion by light absorption of 288 nm using UV-vis spectrometer, the coefficient of the intensity from the experimental was 4.0x10⁶ cm mol/l.

3. RESULTS AND DISCUSSION

3.1. Characterization

The as-synthesized sample was brown, whereas the starting ilmenite mineral was black (Fig. 3a-b). This result indicates that a large portion of Fe impurities were removed by NaOH (aq.) hydrothermal treatment and the neutralization/washing process [23]. An SEM image of the starting ilmenite mineral is shown in Fig. 4; this illustrates the granular structure of the material, with grain size of 150-200 μm. After the hydrothermal treatment, the as-synthesized sample exhibited flower-like morphology (Fig. 5).

Fig. 5(a-c) show the SEM images of the as-synthesized sample at 5,000x, 10,000x, and 20,000x magnification for the group of flower-like morphology. The flower-like structure had a diameter about 3 μm to 5 μm, the flower-like morphology composed of nanosheets. To confirm the formation of nanosheets, TEM analysis was used, and a representative image can be seen in Fig. 6. From the TEM images, it can be observed that the as-synthesized sample showed sheets-like structure. The nanosheets structure was slightly curved and approximately 100 nm to 2 μm in width and several nanometers in thickness. The sheets radiated in all directions to form flower-like morphology.

From the previous works, the size and morphology of TiO₂-derived nanotubes, nanowires or nanofibers depending on the starting materials (ST-01 and natural rutile sand), hydrothermal temperature and time (at 110–150 °C for 72–120 h) [27, 28]. Nanotubes (10 nm in diameter and 1 μm in length) were synthesized from ST-01 (particles size = 4–5 nm) by hydrothermal method at 110–120 °C for 72 h. Nanowires (10–50 nm in diameter and several μm in length) were synthesized from ST-01 (particles size = 4–5 nm) by hydrothermal method at 150 °C for 72 h [29]. Nanofibers (20–50 nm in diameter and 10–500 μm in length) were synthesized from natural rutile sand (particles size = 75–300 μm) by hydrothermal method at 150 °C for 120 h [30]. Nanofibers (20–50 nm in diameter and 10–100 μm in length) were synthesized from natural rutile sand (particles size = 75–300 μm) by hydrothermal method at 150 °C for 72 h [24]. The nanosheets TiO₂ growth under hydrothermal because nanotubes (from nanosheets rolling technique) can be synthesized at 110–120 °C for 48–72 h and dilute base treatment generates thin, curled sheet materials [8, 21].

3.2. Photocatalytic activity

The I⁻ concentration at 60 min of the irradiation period of the as-synthesized nanosheets was about 4.80 × 10⁻⁸ M. (Fig. 7) which is higher than that of the other synthesize(i.e., the white pigment TiO₂, the as-synthesized nanotube from white pigment TiO₂) and the commercial grade TiO₂ nanoparticles (i.e., P-25, JRC-01, and JRC-03) which exhibit I⁻ concentration about 0.15 ×10⁻⁸, 0.57x10⁻⁸, 1.14x10⁻⁸, 0.66×10⁻⁸, and 0.25×10⁻⁸ M, respectively. The introduction of mesopore into titania photocatalyst substantially improved the photocatalytic performance [6]. Jitpitti et al. synthesized flower-like titane nanosheets via hydrothermal method using titanium butoxide as the starting material. The results revealed that the use of the flower-like TiO₂ with unique structure could promote great H₂ evolution(photocatalytic
activity). Preliminary photocatalytic activity measurement showed that the flower-like titanate superstructure show high photocatalytic activity due to their unique structure [8]. The nanosheets have good crystallinity and well-defined chemical composition and exhibit distinctive physicochemical properties. Therefore, these nanosheets become a potential building block for the construction of nano materials in the fields of photocatalysis [31], photoluminescence [32], and photoelectrochemistry [33].

Fig. 3. Photo images of (a) the starting ilmenite mineral and (b) the as-synthesized sample.

Fig. 4. SEM image of the starting ilmenite mineral

Fig. 5. SEM images of the as-synthesized nanosheets at (a) 5,000x (b) 10,000x and (c) 20,000x magnification.

Fig. 6. TEM image of the as-synthesized nanosheets at 100,000x magnification.
4. CONCLUSION

Nanosheets were synthesized by hydrothermal method at temperature of 105 °C for 24 hours using a low-cost ilmenite mineral as the starting material. The flower-like nanosheets structure was slightly curved and approximately 100 nm to 2 μm in width and several nm in thickness. The as-synthesized nanosheets showed the highest photocatalytic activity than that of the commercial nanoparticle TiO₂ samples (P-25, JRC-01, JRC-03).

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REFERENCES


