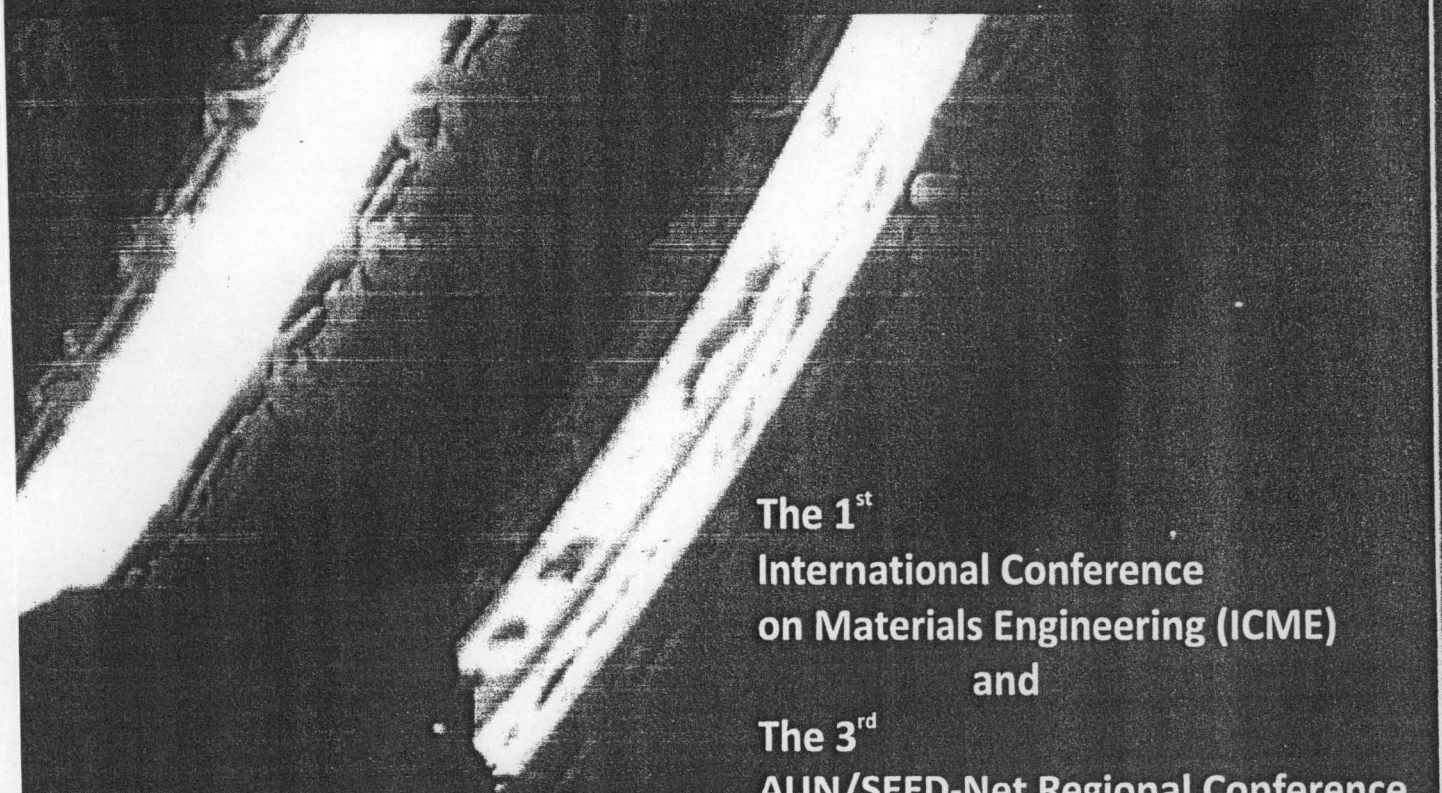
Department of Mechanical and Industrial Engineering
Faculty of Engineering Universitas Gadjah Mada

PROCEEDING
Conference on Materials



The 1st
International Conference
on Materials Engineering (ICME)
and
The 3rd
AUN/SEED-Net Regional Conference
on Materials (RCM)

ASEAN FOUNDATION

AUN / SEED Net

JICA

UGM
Universitas Gadjah Mada

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AUN/SEED-NET REGIONAL CONFERENCE ON MATERIALS

February, 2nd – 3rd 2011
Yogyakarta, Indonesia

DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING
FACULTY OF ENGINEERING UNIVERSITAS GADJAH MADA

INTERNATIONAL CONFERENCE ON MATERIALS ENGINEERING
AUN/SEED-NET REGIONAL CONFERENCE ON MATERIALS

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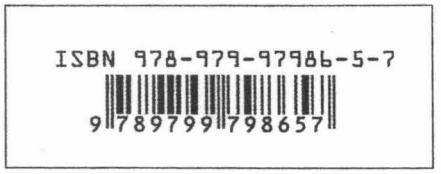

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Opening Remarks by the Rector of Universitas Gadjah Mada

Bismillahirrahmaanirraahiim.
Assalaamu'alaikum warahmatullahi wa barakatuh.

Distinguished guests, Colleagues, Participants, Ladies and Gentlemen,

I would like to welcome all delegates of the First International Conference on Material Engineering (ICME) 2010 and the Third AUN/SEED-Net Regional Conference on Materials (RCM) 2010 to Universitas Gadjah Mada here in Yogyakarta. It is a great pleasure for me to see a large attendance to this meeting.

Please allow me to convey some details about this Conference. It is jointly organized by the Department of Mechanical and Industrial Engineering, Faculty of Engineering of UGM, ASEAN Foundation, ASEAN University Network/Southeast Asia Engineering Education Development Network (AUN/SEED-Net), JICA, and Universiti Sains Malaysia which are the host institution of the Material Engineering field. The International Conference on Materials Engineering (ICME) 2010 is the first event of subsequent series of conferences that we plan to run annually. The Conference is organized in conjunction with the Third AUN/SEED-Net Regional Conference on Materials (RCM) 2010.

The ICME 2010 and the RCM 2010 aim to encourage the sharing of experience and research results about aspects in Materials Engineering among academicians, scientists, researchers, industry practitioners and students. Those will greatly enhance each other's expertise, enabling them to take further steps in the development of this special science. The role of materials science is increasing in recent years. Indeed, this science is an area that is very promising to improve the welfare of human beings. It has the potential to contribute much for a better future of the world. It should serve, however, as a guide that ensures the concept of sustainable development.

To reach that goal, I believe that UGM will continue to work with scientists and industrial companies around the world whilst taking the initiative in leading research and innovative works in the field of materials. I believe UGM researchers, senior and junior, as well as students, will strive hard to help achieve welfare for the better civilization and the happiness of humankind.

To conclude, I would like to express my sincere and profound gratitude to all members of the Conference Committee, the Dean of Faculty of Engineering UGM, and everyone who have made this event a success. I wish you all have a productive gathering as well as a pleasant stay in Yogyakarta. Thank you.

Wassalaammu'alaikum wr. wb.

Prof. Ir. Sudjarwadi, M.Eng., Ph.D.
Rector of Universitas Gadjah Mada

Foreword from the Chief Advisor JICA Project for AUN/SEED-Net

It is a great honor for me once again to have an opportunity to welcome all of you to the 3rd AUN/SEED-Net Regional Conference on Materials Engineering, which is even more special this year as it is jointly organized with the 1st International Conference on Materials Engineering. On behalf of ASEAN University Network / Southeast Asia Engineering Education Development Network (AUN/SEED-Net), I would like to express my sincere gratitude to delegates from prestige Member and other Institutions, and all the people who have worked hard to organize this event, with my special thanks to the ASEAN Foundation, the main sponsor, and to Faculty of Engineering, Gadjah Mada University, the gracious and magnificent host, for successfully organizing this joint event, which will not only provide all participants with a greater chance to share research findings and trends, but also a greater chance to expand collaboration and networking among researchers in this area.

Since the start of the Project Phase I in 2003, more than 120 seminars/conferences have been organized and year by year we have been witnessing significant expansion of participants to non-member institutions inside and outside the region as well as industrial practitioners and government bodies, which indicates the very promising sustainability of this engineering network. And I believe that this network would empower researchers to tackle with ASEAN common socio-economic issues.

Today we have arrived at the middle of the Project's Phase II. So far we have been making efforts in engineering human resources development in ASEAN – which over 700 scholarships for higher degrees have been awarded, and more than half of them have already returned home to serve their roles to build the next generation of engineers. We have significantly enhanced the education and research capacity of member institutions through several types of research grant, and we have been facilitating research collaboration within ASEAN as well as between ASEAN and Japan so as to establish and strengthen this engineering network. And we promise to continue these important missions in a way that will respond to the common needs of the ASEAN region.

I strongly believe that the results of this 3rd AUN/SEED-Net Regional Conference on Materials Engineering will certainly have huge impacts and make path to future innovations and network expansion. Please let me wish all of you the valuable knowledge dissemination, the fruitful prolific discussion, as well as the wonderful stay in Yogyakarta. Let us together look forward to the smooth and successful conference.

Thank you very much.

Prof. Dr. TSUTSUMI Kazuo
Chief Advisor JICA Project for AUN/SEED-Net

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Foreword from the Dean of Faculty of Engineering of Universitas Gadjah Mada

On behalf of the Faculty of Engineering, University of Gadjah Mada (UGM), I have great pleasure in welcoming all of you to The 1st International Conference on Materials Engineering (ICME-2010) dan The 3rd AUN/SEED-Net Regional Conference (RCM) on Materials. I am very pleased that you are able to join us for this conference - your contributions will bring a range of important and valuable perspectives in the development of material engineering to support the sustainable development.

ICME 2010, which is organized by the Department of Mechanical Engineering of Faculty of Engineering of UGM, is conducted in conjuction with the 3rd AUN/SEED-Net RCM on Materials. The AUN/SEED-Net RCM is an annual regional conference organized by a member institution of AUN/SEED-Net and University of Sains Malaysia as the host instituion of the material engineering field. Such cross national cooperation between academic institutions is very important especially under the condition of globalization. This conference also illustrates the close cooperation that has steadily been built-up between institutions involved in the AUN/Seed-Net, a development which has been of considerable benefit to all parties involved in the network.

The conference is not only a place where researchers and graduate students to review the progress of research in material engineering, but also to discuss related activities for further research collaboration. In addition to that, the conference will serve as a venue to collect and disseminate the most updated technology related to material engineering and the research of regional issue and of public interest in order to draw support from the industrial sectors and the governments.

The organization of this seminar would not have been possible without hard work of both steering and organizing committee and support given by JICA and ASEAN Foundation and I would like to take this opportunity of extending my thanks to all of them. Thank you and best wishes.

Dr. Tumiran
Dean of the Faculty of Engineering of Universitas Gadjah Mada

Foreword from the Chairman of ICME and RCM 2010

On behalf of the organizing committee, I would like to express our utmost appreciation to all that have made this International Conference on Materials Engineering and Regional Conference on Materials 2010 (ICME and RCM 2010) accomplished. These included Universitas Gadjah Mada, Universiti Sains Malaysia, AUN-SEED/Net, JICA, ASEAN Foundation, invited Professors from Japanese universities, from ASEAN universities, Indonesian public and Private sector. This make proudly to welcome representatives all the ASEAN countries, Indonesian universities, public organizations, and participation from industrial sector.

The 1st International Conference on Material Engineering 2010 (ICME 2010) and The 3rd Regional Conference on Materials 2010 (RCM 2010) aims to exchange and share experiences and research result about all aspects of Materials Engineering among academic scientists, researchers from ASEAN countries to meet their colleagues from other parts of the world. The conference is expected to pave a path in the advancement of Materials engineering technology, as well as its application. The first International Conference on Materials Engineering 2010. The Conference is the first event of subsequent series of conference that we want to run annually.

And the last, I would like to congratulate my committee members who had worked hard as a team for this event took place smoothly. And then, I would like to thank all the industrial sponsors who had given a lot of support.

Ir. Heru Santoso Budi Rochardjo, M.Eng., Ph.D.
Chairman of ICME and RCM 2010

LIST OF CONTENT

PROCEEDING of
the 1st INTERNATIONAL CONFERENCE on MATERIALS ENGINEERING (ICME) and
the 3rd AUN/SEED-NET REGIONAL CONFERENCE on MATERIALS (RCM)

Ceramics

Composites

Failure Analysis

Metals

Polymers

STUDY OF BIOSYNTHESIS SILICA NANOPARTICLES FROM RICE HUSK USE *FUSARIUM OXYSPORUM*

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[1]*Chemistry Dept. University State Of Jakarta*
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Abstract:Silica nanoparticles biosynthesis utilizing rice husk as a source of silica as well as a substrate for the growth *Fusarium oxysporum*. *Fusarium oxysporum* was grown in media pH 4-6, incubation temperature 27 ° C, 4 / 5 empty space and aeration system with an orbital shaker 200 rpm. Harvesting biomass *F.oxysporum* done at 72 hour, ie when the cells entered the stationary phase based on the growth curve. SEM analysis results seen loamy to each other and have a particles size with variations in size between 200-1000 nm. Three peak which has the highest peak of the 12 peak is found in the FTIR absorption spectrum, which is located at 3408.18 cm^{-1} for H_2O clusters, 1639.04 cm^{-1} to cluster CO_3^{2-}, and 1078.71 cm^{-1} for the group Si-O-Si this shows the husk of with *F.oxysporum* treatment has changed the structure of basic forms (amorphous)

Keywords: Silica nanoparticles, Fusarium oxyporum

1.Intoduction

Fusarium oxysporum can be used in the biosynthesis of silver nanoparticles sized 20-50 nm (1), gold nanoparticles (2), and 5-15 nm-sized titania nanoparticles (3). Recent research reported is the nanoparticles synthesized by using natural materials as a substrate. Bansal et al. (3)utilizing sand to synthesize sillica.Silica nanoparticles has several such properties, large surface area, good heat resistance, high mechanical strength, and inert to be used as a precursor catalyst (4,5), a adsorbent (6) , and as a filter composite (7). The presence of silica (SiO_2) in gramineae plants has been known since 1938, rice (Oryza sativa) that are members of gramineae families known to contain silica.

According to Soepardi (10), the highest silica content in rice contained in the husk. Rice husk can be used as a source of substrate in the biosynthesis of nanoparticles of silica (SiO_2). Rice husk is the raw waste-based agriculture is cheap and rich in silica. From the grain milling process will produce 16.3 to 28% husk. A total of 16.98% silica contained in the husk (8). Inorganic silica material contained in the husk, is in basic form amorphous silica(3).Based on the description above, this study is the biosynthesis silica nanoparticles using *Fusarium* to produce enzymes that can reduce silica in rice husk.

Biosynthesis of nanoparticles is the development of new technology by producing metal nanoparticles of microbial cells and involves the enzymatic reaction.

Biosynthesis of nanoparticles takes place in a variety of specific mechanisms. The mechanism includes, efluksi system, oxidation-reduction reaction, bioabsorption, bioaccumulation, precipitation metal, and metal-specific transport system. One mechanism in the creation of metal nanoparticles is to use a specific enzyme that can reduce, such as NADH reductase. Assay showed that the NADH reductase proteins known as enzymes involved in the biosynthesis of metal nanoparticles and is an important factor responsible for the biosynthesis process. Reductase gain electrons from NADH and oxidize into NAD. This enzyme in *F.oxysporum* conjugated with electronverrt it inti another donor named quinine. This enzyme then reduces the metal ions and convert it into another form(1)

Reductase enzyme in the biosynthesis produced *F.oxysporum* silica nanoparticles is specific. Silica nanoparticles formed likely is the product of the exchange of electrons by a specific reductase F.oxysporum as shown in Figure 1. Based on the enzymes produced by microbial reduction, the techniques are classified into metallic nanoparticles biosynthesis of intracellular and extracellular. Biosynthesis in intracellular implement an on going process of synthesis in the cell. The process of detoxification of harmful metals is mediated by an enzymatic reaction that lasted through bioreduksi. metal and occurs in the cell. Through this mechanism, the nanoparticles obtained from cells with a specific method (9).

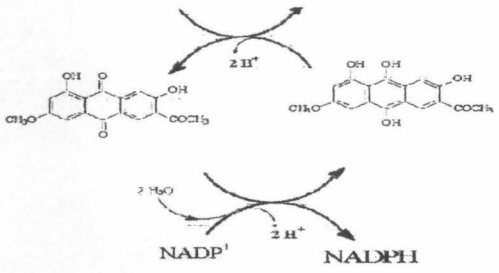

Fig1. Mechanism of metal nanoparticle logam biosynthesis

Silica is a material that is available in natural and quantitatively have big numbers. Plants have a significant role in the biogeochemical cycle of silica. Silica in the soil are in the form of water soluble silica (H_4SiO_4). Inside the plant polymerized and precipitized into amorphous silica forms. Some carbohydrates and plant proteins are known to have a role in the polymerization of amorphous silica biosilica into a form similar to the form of silica contained in the biosphere. After the plants die silica back into the ground and on going microbial activity (10).

Compared with other section of rice plants such as leaf blade, midrib of leaves, stems, and roots. In rice husk (gramineae) is a hard coating that wraps kariopsis grains, consists of two parts, called lemma and palea are interlocked. Husk will separate from the grain of rice and the agricultural waste materials or waste grain milling in the milling process (3). From the grain milling process will produce 16.3 to 28% husk. Chaff is categorized as a biomass that can be used for various needs such as industrial raw materials, fodder, and energy (8).

Silica is specifically used in various applications, such as resins, molecular filters, supporting the role of catalyst, and filler in the manufacture of polymers. In addition, silica is currently being developed in the field of biomedical applications (3). Silica is currently being developed, is silica as a porous inorganic material nanostrukur. Shaped silica nanoparticles have several advantages as a low-density particles, particles that are thermally stable, and also as a structure that can be packaged in capsules, as well as resistance to mechanical processes in the application(3).

2.Experiments

This research was conducted in three stages of construction, which include: rejuvenation and manufacture of liquid *Fusarium oxysporum* isolates, and harvesting the growth curve of *Fusarium oxysporum* isolates, and the synthesis of silica nanoparticles. Rejuvenation and manufacture of liquid isolates of *Fusarium oxysporum*. Isolates of *Fusarium oxysporum* to be rejuvenated taken transferred into a petri dish containing PDA medium, this process is done in laminar flow. *Fusarium oxysporum* which was grown on PDA, then incubated at 27 ° C for 96 hours up to the cup fungi Fusarium oxysporum fulfill thepetri.Isol at stocks that were grown in PDA inoculated in Erlenmeyer flask containing 10 mL PDL (Potato dextrose liquid) which is a starter inoculum. Inoculum starter then incubated for 12-18 hours. As many as 1% inoculum of starter was inoculated into 50 mL medium PDL.

2.1.Materials and Method

Materials and Equipment

The materials use in this study is isolate fungi *Fusarium oxysporum*, rice husks, distilled water, phenol-chloroform, Potato Dextrose Agar (PDA), HCL and NaOH. The tools used include Laminar Air Flow, incubators, centrifuge spectrophotometers (spectronic 20), Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) and X-Ray Diffraction (XRD)

2.2. Prepare curve of growth of *Fusarium oxysporum*

Isolates *Fusarium oxysporum* growth was measured biomass grow'ns in potato dextrose liquid medium (PDL). The liquid of fusarium oxysporum isolates the PDL measured optical density (OD) use spectrophotometer at a wavelength of 600 nm and 12-hour time intervals, ie at the 0,12,24,36,48,60,72,84,and96

2.3.Synthesis of Silica Nanoparticles

The first treatment carried out with 50 mL of aquadest contain's husk aquadest included in the autoclave. Second treatment performed with 50 mL of containing 2.5 grams husk put into the autoclave. Then, the biomass of *Fusarium oxysporum* that have been harvested as many as 10 grams resuspensize in aquadest contains husk. The reaction between the biomass of fungi was conducted in an incubator for 24 hours. The suspension is filtered so it can be separated from mycelial fungi and chaff from the components of water (filtrate product). The filtrate obtained was treated phenol-chloroform (1:1) and centrifuged at 6000 rpm. The next stage is the crystallization of silica nanoparticles, filtrate of silica was made in the form of

crystals with dry spray technique, thus obtained in powder form. These powders were characterized use SEM and FTIR.

3.RESULTS AND DISCUSSION

3.1.Growth of Fusarium oxysporum Isolates Liquid

The color of the original media began to turn from clear become turbid clear at the 12th, thus indicating that at the hour 12th occurred lag and acceleration phases. Harvesting biomass *F.oxysporum* done hour 72th, ie when the cells entered the stationary phase based on the growth curve obtained. Stationary phase is determined as the time of harvest for *F.oxysporum* as expected in that phase the number of cells that grow relatively balanced, (Gandjar 2006). It is also in accordance with studies conducted Bansal et al. (2002) and Bansal et al (2005), *F.oxysporum* grown for 72 h in aeration conditions on the shaker speed of 200 rpm and incubated at 27 ° C.

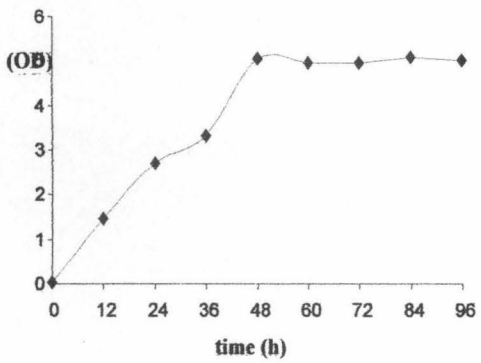

Fig 2. F.oxysporum growth curve.

3.2.Silica nanoparticles as a result of biosynthesis F.oxysporum

Biosynthesis of silica anoparticles made by growing *F.oxysporum* in media contains rice husk as a source of silica as well as a substrate for the growth *F.oxysporum*. Husk that contains 16.98% silica (Post-Harvest Research Center of Agriculture 2001) can be changed to silica nanoparticles by using *F.oxysporum* biosynthesis. Components contained in the husk, which can be exploited by *F.oxysporum* cellulose as a substrate in their life cycle .

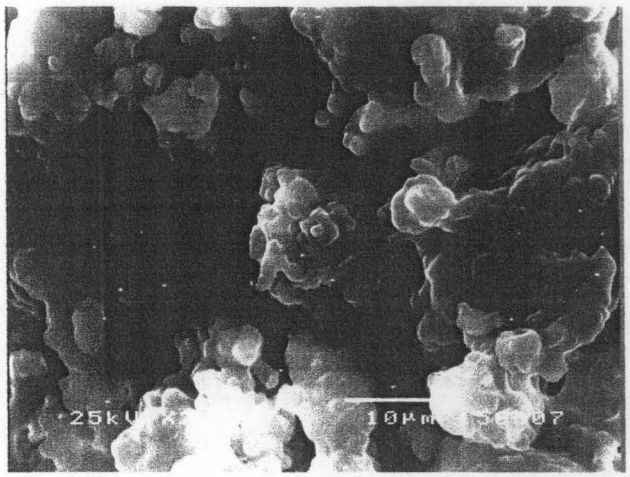

Fig 3. SEM images of silica synthesized using F oxysporum

Fig 3. SEM showed the reaction product biosynthesis *F.oxysporum* with 5 grams of rice husk for 24 hours at 2,000 times magnification. Particles seen loamy one another. Nanoparticles formed actually do not directly attached to one another as the result of biosynthesis of silver nanoparticles is performed by (1). This is because of nanoparticles stabilized by proteins in the culture that is secreted by *F.oxysporum* coversone of the proteins that play a role in this regard is cytochrome C

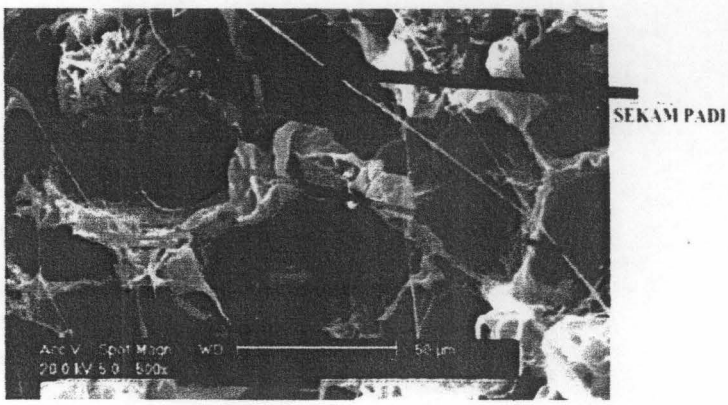

Fig 4. SEM images of husk

Figure 4 is a husk without treatment *F.oxysporum* as a comparison or a negative control, to prove that the product biosynthesis have indicated smaller than husk. Particle biosynthesis results appear to have different variations in size between 200-1000 nm (Fig. 3). Husk particle size without treatment *F.oxysporum* in figure 4 is 50 µm. These

results prove that the particle size before and after the husk treated *F.oxysporum* has narrowed. This indicates that the extracellular enzymes released F.oxysporum has worked in reducing the husks so that formed product biosynthesis with the size of 200-1000 nm.
FTIR analysis conducted to more detail the analysis of product biosynthesis. This analysis is based on the infrared spectrum at every functional group of a molecule that is specific. Absorption spectrum for $SiO4^{4-}$ functional group is 1200-900 cm^{-1} and clusters of Si-O-Si in the range of 1000-1110cm^{-1}.

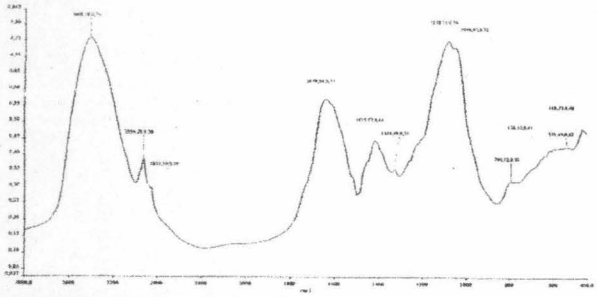

Fig 5.spctra recorded from silica particle synthesized from Husk by F. Oxysporum

of substrate indicate presence of silica . There is a spectral absorption peak 1078.71 cm^{-1} is indicated as the absorption spectrum of silica due to cluster-$Si_xO_y^2$ is at 1200-900 cm^{-1}. However, other functional groups found $Si_xO_y^2$, CO_3^{2-} functional groups that are in pektrum absorption of 1639.04 cm The result of FTIR spectrum of the product biosynthesis with the addition of 5 grams $^{-1}$ and H_2O absorption spectrum located at 3408.18 cm^{-1}. The presence of functional groups containing carbon, indicating that there are still untapped cellulose by *F.oxysporum*.

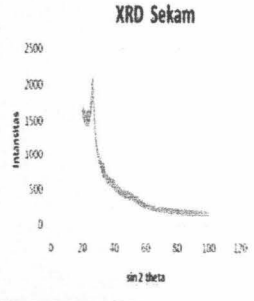

Fig 6. XRD of husk

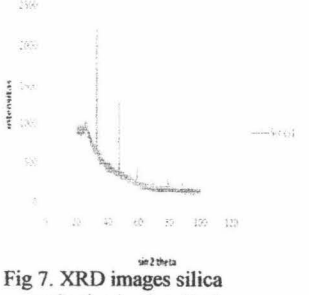

Fig 7. XRD images silica synthesized using *F. Oxysporum*

Characteristics of the structure of biosynthetic products were analyzed using XRD. The results of the analysis by XRD diffraction peaks. . Figure 6. is the diffraction peak for the husks without treatment *F.oxysporum* and treated as a negative control. Inorganic silica material contained in the husk, is in the basic structure amorphous silica (3).
Figure 7. is a diffraction peak which is a product biosynthesis husk with *F.oxysporum* treatment. Diffraction peak is different products biosynthesis of diffraction peaks of chaff, there are several peaks at sin 2 theta 22° and 44° . Based on these results it can be said that the husk with *F.oxysporum* treatment changes the structure of basic forms (amorphous) change to silica crystalline.

4.Conclusion

The results showed that life time *F.oxysporum* for biosynthesis of silica nanoparticles was 72 hours . SEM results showed that particles with sizes varying between 200-1000 nm and aggregate. FTIR results already indicate the existence of clusters of Si-O-Si. Husk experiencing changes in the structure of basic forms (amorphous) and indicate the form of crystalline silica nanoparticles (crystoballite) based on XRD analysis.

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