



2017

**INTERNATIONAL CONFERENCE
ON INNOVATION IN EDUCATION,
SCIENCE AND CULTURE**

Grand Mercure Hotel
08 - 09/11/2017

**BOOK
OF
PROGRAM**



Organized by:
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Chair Foreword

The honorable,

- Professor Dr. Syawal Gultom, M.Pd, Rector of Universitas Negeri Medan
- Professor Dr. Jakrapong Kaewkhao, Director of the Center of Excellence in Glass Technology and Materials Science (CEGM), Nakhon Pathom Rajabhat University (NPRU), Thailand
- Rosemarie Daher Kowalski, Ph.D, Intercultural Studies, Research Methodology and Writing in Northwest University USA
- Professor Dr. Atty Cecilio D. Duka, Ed. D, Director Recoletos Law Center, San Sebastian College of Law – Manila
- Dr. Mati Horprathum (Researcher at The National Electronic and Computer Technology Center – NECTEC, Thailand)
- Vice Rectors
- Deans of Faculties of Education, Languages and Arts, Social Sciences, Natural Sciences and Mathematics, Engineering, Sports Sciences, and Economics
- Director of Postgraduate School of UNIMED
- Lecturers, researchers, students, all speakers and participants

Good Morning, *Salam Sejahtera*, Praise to Allah the Almighty for all His blessing, where today we are here to participate in 'The First International Conference on Innovation in Education, Science and Culture (ICIESC)' with the theme "Innovation Making Better Life".

Ladies and Gentlemen,

This conference presents a keynote speaker, 4 plenary speakers from Thailand, Philippine, United States of America (USA) and Indonesia. Besides speaker, around 220 researchers covering lecturers, teachers, participants and students have attended in this conference. The researchers come from Manado, Palu, Kendari, Malang, Surabaya, Bandung, Jakarta, Palembang, Jambi, Batam, Pekanbaru, Padang, Aceh, Medan and several from Malaysia, Philippine and Thailand.

I would like to express greatest thankful to all colleagues in the steering committee for cooperation in administering and arranging the conference. Hopefully this conference will be continued in the coming years with many more insight articles from inspiring research.

Regards.

Chairperson of ICIESC

Dr. Juniastel Rajagukguk, M.Si

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**Welcoming Speech of Chairman of Research Institute, State University of Medan
International Conference on Innovation in Education, Science and Culture (ICIESC)**

On behalf of the 1st International Conference on Innovation in Education, Science and Culture (ICIESC) committee, I wish to welcome all of the participants to the conference being held during November 8 – 9, 2017 at Grand Mercure Hotel, Medan Sumatera Utara, Indonesia.

Welcome the honorable guests speakers Professor Syawal Gultom, M.Pd, Professor Jakrapong Kaewkhao, Rosemarie Daher Kowalski, Ph.D, Professor Atty Cecilio D. Duka, Ed. D and Dr. Mati Horprathum. Welcome also delivered to Vice Rectors, Deans of Faculties of Education, Languages and Arts, Social Sciences, Natural Sciences and Mathematics, Engineering, Sports Sciences, and Economics, Director of Postgraduate School of UNIMED, other speakers, and participants from outside and inside Unimed.

This conference is one of the manifestations of the vision and mission of Research Institute (Lemlit) of Unimed, namely the dissemination and implementation of the results of research and studies related to the community. Therefore we strongly support the activities of this seminar which is also a series of academic activities of Unimed. Through this seminar, the participants will exchange information related to the latest research in the field of education, science-technology and culture which is expected to bring new ideas in solving various problems.

In accordance with the theme presented in this conference "Innovation Making Better Life" it is expected that LemlitUnimed can lead and strengthen the future research. The goal of innovation is to improve of research quality especially for education, science, technology and culture. Through innovation in education, science and culture, the human resources will be capable for solving global crises such as internationally political conflicts, climate change and loss of biocultural diversity.

Thank you for all committee to has well organized this conference. Thanks to all keynote speakers who have attended, presented and shared their ideas on education, science and culture. Thanks to all researchers, students and participants and hopefully this will be scientific discussion to develop the future innovation.

Finally, I hope that all academicians and stakeholders of LemlitUnimed hand-in-hand to excel our institution to be a world class university.

Best wishes for all of us
Chairman of Lemlit Unimed

Prof. Motlan, M.Sc.,P.hD

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RECTOR WELCOMING SPEECH
International Conference on Innovation in Education, Science and Culture (ICIESC)

The honorable,

- *Professor Dr. Jakrapong Kaewkhao, Director of the Center of Excellence in Glass Technology and Materials Science (CEGM), Nakhon Pathom Rajabhat University (NPRU), Thailand*
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- *Director of Postgraduate School of UNIMED*
- *Lecturers, researchers, students, all speakers and participants*

AssalamualaikumWrWb

Good Morning, Praise to Allah the Almighty for all His blessing, where today, we could all gather here in order to attend 'The International Conference on Innovation in Education, Science and Culture (ICIESC) with theme is "Innovation Making Better Life".

Ladies and Gentlemen,

Organizing international conference at State University of Medan (Unimed) will be constantly developed because by presenting several conferences covering all disciplines we will get a lot of inspiring inputs and new knowledge or current trending scientific topics in this world. Through this conference we will continue to promote research in field of education, science, technology and culture at Unimed. Innovatioin in some fields especially in learnig process are continuously improved.

The expectation is that all of lecturers and researchers will innovate in education, science, technology and culture that Unimed proposes the Institute of Research (Lemlit) can be encouraging educators and researcher for improving quantity and quality of research.

Let us awaken scientific attitude and skills in promoting Unimed to be a world class university and well-known which persists to be developed and excelled.

Wassalamualaikum Wr. Wb.

Rector of Unimed

Prof. Dr. Syawal Gultom, M.Pd.



Committee of ICIESC

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Dr. Martina Restuati, M.Si (Secretary of Research Institute of Unimed)

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Professor Snezhana Abarzhi (Australia)

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Papers and Proceedings

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Consumption	Rosmina Purba Rizki Fadhillah
Receptions	Rahma Diana Asmawati

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[PS-1]

Luminescence Material from Glass Doped Ln³⁺ and Their Applications



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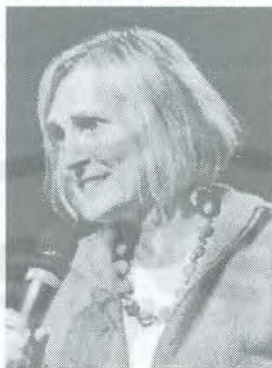
Glasses are source of material have properties like low cost, easy to prepare, high transparency at room temperature, hardness along with sufficient strength, excellent electrical resistance, absence of the grain boundaries and continuously variable composition for the optical applications. Glasses doped with Lanthanide ions (Ln³⁺) can be well developed as luminescence materials because of high emission efficiencies, corresponding to 4f–4f and 4f–5d electronic transitions in the Ln³⁺. The 4f–4f transition gives an especially sharp fluorescence patterns from the ultraviolet to the infrared region, because of shielding effects of the outer 5s and 5p orbitals on the 4f electrons. In this review, up and down conversion luminescence properties of the glasses doped with several lanthanide ions, i.e., Ce³⁺, Nd³⁺, Sm³⁺, Eu³⁺, Dy³⁺, Er³⁺ and Tb³⁺ have been explain. Moreover, the current status of their potential applications of Ln³⁺doped glasses are also given.

Keywords Glass; Lanthanide; Luminescence

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[PS-2]

Connected and Collaborative: 3 Trends in Education



Rosemarie Daher Kowalski

Intercultural Studies, Research Metodology and Writing in Northwest University USA

Abstract - As students and faculty members become more and more connected online, collaboration can enhance educational research, classroom communication, and learning partnerships within the institution and beyond. How can educational experiences and a university classroom reflect this interactive reality? Here are three innovative trends worth noting.



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[PS-3]

Unity in Diversity in Education: The Philippine Experience



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Unity

It is the state of being one; oneness. A whole or totality as combining all its parts into one. The absence of diversity; unvaried or uniform character. (dictionary.com)

Diversity

The concept of diversity encompasses acceptance and respect. It means understanding that each individual is unique, and recognizing our individual differences. It is the exploration of these differences in a safe, positive, and nurturing environment. It is about understanding each other and moving beyond simple tolerance to embracing and celebrating the rich dimensions of diversity contained within each individual. These can be along the dimensions of race, ethnicity, gender, sexual orientation, socio-economic status, age, physical abilities, religious beliefs, political beliefs, or other ideologies.

Scope of what constitutes diversity

According to Dr. James Banks, African American professor in the University of Washington, diversity may be seen in the following: social class, ethnicity, race, language, abilities and disabilities, religion, sexual orientation and gender among others.

Etymology of Unity in Diversity

Unity in diversity was adopted as the official motto of the European Union in 2000, referring to the uniqueness of each of the nations belonging to the EU as well as to the intention of all the nations belonging to the organization to forge a common identity. Very soon after its adoption, the motto was changed to "United in diversity." Each member of the EU expresses the motto in its own language.

Principles that would help create unity in diversity in the schools.

The following are some of the principles laid down in a study published in 2001 by the University of Washington College of Education:

1. Professional development programs should help teachers understand the complex characteristics of ethnic groups within the society and the ways in which race, ethnicity, language, and social class interact to influence student behavior.

Since the Philippines with more than 1000 islands, has a diverse ethnic groupings and cultural traits, these differences are taken into account in the teacher training as well as professional development programs of educators. There are more than 175 ethnolinguistic groups in the Philippines. These ethnolinguistic groups include the Ivatan, Ilocano, Pangasinense, Kapampangan, Tagalog, Bicolano, Cebuano, Ilongo, Waray, Surigaonon, Zamboangueno, Subanon, Masbateno, Maranao, etc.

Professional Development Programs should help educators to: (1) uncover and identify their personal attitudes toward racial, ethnic, language, and cultural groups; (2) acquire knowledge about the histories and cultures of the diverse racial, ethnic, cultural, and language groups within the nation and within their schools; (3) become acquainted with the diverse perspectives that exist within different ethnic and cultural communities; (4) understand the ways in which institutionalized knowledge within schools, universities, and popular culture can perpetuate stereotypes about racial and ethnic groups; (5) acquire the knowledge and skills needed to develop and implement an equity pedagogy, as instruction that provides all students with an equal opportunity to attain academic and social success in school.

2. Schools should ensure that all students have equitable opportunities to learn and to meet high standards.

Based on this idea the schools have duties in the areas of: (1) teacher quality; (2) a safe and orderly learning environment; (3) time actively engaged in learning; (4) student-teacher ratio; (5) rigor of the curriculum; (6) grouping practices (7) sophistication and currency of learning resources and information technology; and (8) access to extra-curricular activities.

3. The curriculum should help students understand that knowledge is socially constructed and reflects researchers' personal experiences as well as the social, political, and economic contexts in which they live and work.

In the curriculum and teaching units and in textbooks, students often study historical events, concepts, and issues only or primarily from the points of view of the victors. The perspectives of the vanquished are frequently silenced, ignored, or marginalized.

The Philippines has reviewed and revised its curriculum to help its students become globally competitive. Among these measures are the following laws: Batas Pambansa Blg 232 – Education Act of 1982; Republic Act No. 10157 - Kindergarten Education Act; Republic Act No. 10533 - The Enhanced Basic Education Act of 2013.

4. Schools should provide all students with opportunities to participate in extra- and co-curricular activities that develop knowledge, skills, and attitudes that increase academic achievement and foster positive interracial relationships.

There is significant research that supports the proposition that participation in co-curricular and extracurricular activities, and school-sponsored social activities contributes to academic performance, reduces high school drop-out rates and discipline problems, and enhances interpersonal skills among students from different ethnic backgrounds.

5. Students should learn about stereotyping and other related biases that have negative effects on racial and ethnic relations. Making crosscutting group memberships salient can reduce prejudice because it is hard to dislike people with whom you share important aspects of your identity. These are aspects of identity (religion, age, sex) that people share with some of the members of their own racial or ethnic group but not with other members.

The Philippine constitution respects freedom of religion. Article III, Section 5 of the said Constitution provides: No law shall be made respecting an establishment of religion, or prohibiting the

free exercise thereof. The free exercise and enjoyment of religious profession and worship, without discrimination or preference, shall forever be allowed. No religious test shall be required for the exercise of civil or political rights. Moreover, Under Article XIV, Section 5(3): At the option expressed in writing by the parents or guardians, religion shall be allowed to be taught to their children or wards in public elementary and high schools within the regular class hours by instructors designated or approved by the religious authorities of the religion to which the children or wards belong, without additional cost to the Government. Article XIV, Section 3(3).

The diversity of religions in the Philippines is as follows based on statistics: Catholic - 80.58%; Islam - 5.57%; Evangelicals (PCEC) - 2.68%; Iglesia Ni Cristo - 2.45%

6. Students should learn about the values shared by virtually all cultural groups (e.g., justice, equality, freedom, peace, compassion, and charity).

Teaching students about the values that virtually all groups share, such as those described in the UN Universal Bill of Rights can provide a basis for perceived similarity that can promote favorable intergroup relations. The following are the basic human rights that should be taught to children: Basic Human Rights, Right to Equality, Freedom from Discrimination, Right to Life, Liberty, Personal Security, and Freedom from Slavery, Freedom from Torture and Degrading Treatment, Right to Recognition as a Person before the Law

Human Rights in the Philippines

Under Section 17, Article XIV of the 1987 Constitution there is hereby created an independent office called the Commission on Human Rights. The teaching of human rights is included in the school curricula, in textbooks, and other reading materials and in the qualifying examinations on government service is also provided by Executive Order 27 issued on July 4, 1986.

7. Teachers should help students acquire the social skills needed to interact effectively with students from other racial, ethnic, cultural, and language groups.

Being the target of stereotyping, prejudice, and discrimination is a painful experience. People react in a variety of ways, many of them potentially damaging. For instance, people respond with anger, rage, and violence, they reciprocate the prejudice and discrimination, or they can accept the stereotypes as potentially applicable to them.

8. Schools should provide opportunities for students from different racial, ethnic, cultural, and language groups to interact socially under conditions designed to reduce fear and anxiety.

Xenophobia – the intense or irrational dislike or fear of people from other countries.

9. A school's organizational strategies should ensure that decision-making is widely shared and that members of the school community learn collaborative skills and dispositions in order to create a caring environment for students.

Safe and Caring School

According to the National School Climate Center, Columbia University, a safe and caring school environment is one in which students feel positively connected to others, respected, that their work is meaningful, and that they are good at what they do.

10. Teachers should use multiple culturally sensitive techniques to assess complex cognitive and social skills.

Diversity in the Classroom. A multicultural classroom is one in which both the students and the teacher are accepting of all races, cultures, and religions. This acceptance is evidenced by the books that are read, the activities that are completed, and the lessons that are taught.

The Madrasah Program in the Philippines

Madrasah is an Arabic word which means school. Madrasah education is a system of education which emphasizes on Arabic literacy, Islamic values (universal moral values based on Islam), and the Islamic religion. The Madrasah education program was formulated to meet the needs of Muslim Filipino children. According to DepEd Order 51, signed in 2004, all public and private schools in Muslim communities are encouraged to implement the curriculum madrasah.

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2. *Labor Laws and Social Legislations: A Barrister's Companion* (Rex Bookstore, 2016)
3. *Constitutional Law: A Barrister's Companion* (Rex Bookstore, 2010)
4. *Rizal, His Legacy to the Philippine Society* (Anvil Publishing House, 2010)
5. *The Struggle for Freedom: A Textbook in Philippine History* (Rex Bookstore, 2008)
6. *The Law and the Teaching Profession in the Philippines* (C and E Publishing, 2008)
7. *Philosophy of Education* (Rex Bookstore, Inc., 2006, 1999)
8. *Reviewer for the Civil Service Examination* (Manila Review Institute, Inc., 2015, 2001)
9. *World Geography* (Rex Bookstore, Inc., 2006, 2001)
10. *Introduction to Asia: History, Culture and Civilization* (Rex Bookstore, 2005)
11. *Reviewer for the Licensure Examination for Teachers* (MRI, 2017, 2013, 2006, 1998)
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13. *Introduction to Sociology* (Anvil Publishing), 2014



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[PS-4]

Research and Development of Thin Film and Nanostructure at NECTEC, Thailand



Mati Horprathum

Abstract - Thin films and nanostructured coatings have attracted enormous attention for the development of optical coatings, sensors, optoelectronic devices, photocatalysis and solar cells. In this work, we present the overviews of the fabrication techniques based on physical vapor deposition, i.e., magnetron sputtering, electron beam evaporation, and the optical spectroscopic characterizations, i.e., spectroscopic ellipsometry, spectrophotometry, which have been developed at Optical Thin-Film Technology Laboratory, NECTEC, Thailand. We would further discuss our accomplished work, which have been realized through the synergy of theories and experimentations, and utilizes the technologies toward local industrial manufacturers. In addition, we will also discuss the potentials of the fabrications to improve towards recent applications i.e. self-cleaning glasses, omnidirectional anti-reflection coatings, transparent conductive oxides, surface enhanced Raman scattering (SERS) substrates, ultra-sensitive nanostructural gas sensors, birefringence nanostructure thin films, high surface area photocatalytic nanostructures and their future developments.

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[ABS-149]

The Effect of Spinning Velocity on Structural and Optical Properties ZnO Thin Film Synthesized using Sol-Gel Spin Coating Method.

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Abstract - ZnO thin film has been synthesized using sol-gel spin coating method and reflux mixing technique process. The surfactants are Zinc acetat dehydrate $Zn(CH_3COOH)_2 \cdot 2H_2O$, etanaol dan diethanolamine (DEA) consecutively used as based material, solvent, and stailizer. The molar ration between DEA and ZnAc were 1:1. The ZnO film was grown on a glass substrates using spin-coating technique with the speeds of consecutively 3000, 4000 and 5000 rpm, each for 30 seconds and calnination with pre-heating 300oC and post-heating 500oC temperatures. The structural characterization results show the thin ZnO films are hexagonal and the smallest crystal size was 24.9 nm at the spinning speed of 5000 rpm. The optical characterizations show that the highest transmission is 52.6 % at the spinning speed of 3000 rpm and the highest absorption is 1.277 at the spinning speed of 5000 rpm, and the smallest band gap of 3.13 eV at the spinning speed of 5000 rpm.

Keywords: crystal structure, optical properties of ZnO thin film, spinning speed



The effect of spinning velocity on structural and optical properties ZnO thin film synthesized using Sol-Gel spin coating method

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Abstract

ZnO thin film has been synthesized using sol-gel spin coating method and reflux mixing technique process. The surfactances are Zinc acetat dehydrate $Zn(CH_3COOH)_2 \cdot 2H_2O$, etanaol dan diethanolamine (DEA) consecutively used as based material, solvent, and stailizer. The molar ration between DEA and ZnAc were 1:1. The ZnO film was grown on a glass substrates using spin coating technique with the speeds of consecutively 3000, 4000 and 5000 rpm, each for 30 seconds and calnination with *pre-heating* 300°C and *post-heating* 500°C temperatures. The structural characterization results show the ZnO thin films are hexagonal and the smallest crystal size was 24.9 nm at the spinning speed of 5000 rpm. The optical characterizations show that the highest transmission is 52.6 % at the spinning speed of 3000 rpm and the highest absorption is 1.277 at the spinning speed of 5000 rpm, and the smallest band gap of 3.13 eV at the spinning speed of 5000 rpm.

Key words: crystal structure, optical properties of ZnO thin film, spinning speed.

1.INTRODUCTION

The ZnO thin film has gain interest due to it's unik optical, electrical properties, and easy to prepare. The ZnO thin film material is belong to II-VI semiconductor compound with band gap of about 3.3 eV and bond excitation energy of 60 mV at room temperature [1,2]. The ZnO has the emission that close to UV, photocallist, and high conductivity and transparency, that is used in sensor, solar cell, and nanodevice [3]. The ZnO thin films can be synthezed using various methods such as molecular beam epitaxy-MBE, RF magnetron sputtering, pulsed laser deposition, spray pyrolysis, chemical bath deposition, physical vapor deposition, sol-gel dip coating and spin coating [4-12].

Sol-gel spin coating method has some benefits such as low cost, do not need high vacuum, homogen composition, controllable film thikness, and good microstructures [13]. Sol-gel spin coating is method to grow thin film from photoresist polymer using plane silicon substract. Sol-gel is dropped on the substract then spinned with sentrifugal until homogen thin film is formed. The controlled parameters are spinning speed, solution, and time.

2. EXPERIEMENT

Zinc acetat dehydrate $\text{Zn}(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$ sare used as *precursor* which was diluted in *etanol* solution with concentration of 0.8 M, the solution then was stablized with *diethanolamine (DEA)* with DEA and ZnAc molar ratio of 1:1. The mixing prosses uses *refluks* technique to control reaction speed and to isolate synthesis prossesses from air. The solution then stirred with magnetic strierr with spinning speed of 60-70 rpm at temperature of 60–85°C in about 60 minutes until clear and transparance were obtained. Coating was conducted by putting the substrates on the coater spin plate and the sol was dropped on the substrate sample then dried in a furnace with temperature of 100°C for 10 minutes. To improve sample qualities, the sample was heated (*pre-heating*) gradually from room temperature until it reached 300°C in every in for 5 hours by using furnace, then the sample kept at 15 minutes before it cooled down gradually to room temperature. *Annealing (post-heating)* was also conducted by increasing temperature gradually until the sample temperature reached 500°C in 5 hours. The sampe temperature was also kept 500°C for 15 minutes before cooled down gradually to room temperature.

3. RESULTS AND DISCUSSION

3.1. Crystal structure of ZnO thin film

The synthezed ZnO thin film then characterized using X-ray diffraction (XRD). Figure 1 shows the diffraction patterns of synthesized thin films of different spinning speed which are 3000, 4000 and 5000 rpm. The lattice constant, *a* and *c*, ZnO *wurtzite hexagonal* can ba calculated with the following equation [14]:

$$a = \sqrt{\frac{1}{3} \frac{\lambda}{\sin \theta}} \quad (1)$$

$$c = \frac{\lambda}{\sin \theta} \quad (2)$$

The diffraction patterns then were analyzized using search march, the results show that the crystal plane are (100), (002) dan (101) planes. All the growth peaks at the (101) orientation are ZnO hexagonal structure. The lattice parameters of crystals synthesized with spin rate of 3000, 4000 and 5000 rpm are concecutively: *a* = 3.2533 Å, *c* = 5.2073 Å; *a* = 3.2494 Å, *c* = 5.2038 Å and *a* = 3.2553 Å, *c* = 5.2073 Å. The *c/a* ratios, for the consecutive spinning, are: 1.601; 1.601 dan 1.600. The *c/a* ideal ratio of hexagonal cell is 1.602 [15]. ZnO crystal structures are hexagonal wurtzite which is inline with ZnO standard card JCPDS 80-0075.

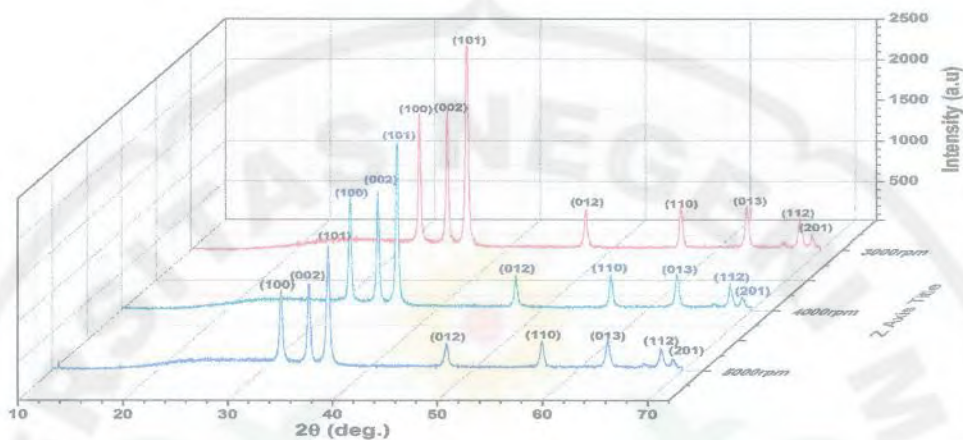


Figure 1. The XRD spectrums of various spinning rate during the ZnO thin film synthesis.

The ZnO crystal sizes shown in table 1 were obtained using Scherrer equation [16]:

$$D = \frac{0.9\lambda}{\beta \cos\theta} \quad (3)$$

Where D is crystal size, λ is the wavelength, β is FWHM (full width half maximum), and θ is diffraction angle.

Table 1. The ZnO crystal sizes of various spinning rate during the synthesis processes.

Spinning rate (rpm)	phase	Peaks		Crystal sizes (nm)
		2θ (degree)	FWHM(degree)	
3000	ZnO	36.2981	0.2570	32.6
4000	ZnO	36.2528	0.2907	28.8
5000	ZnO	36.2744	0.3358	24.9

Figure 2 and 3 show the relation between spinning speed and crystal sizes as well as the value of *FWHM* of table 1.

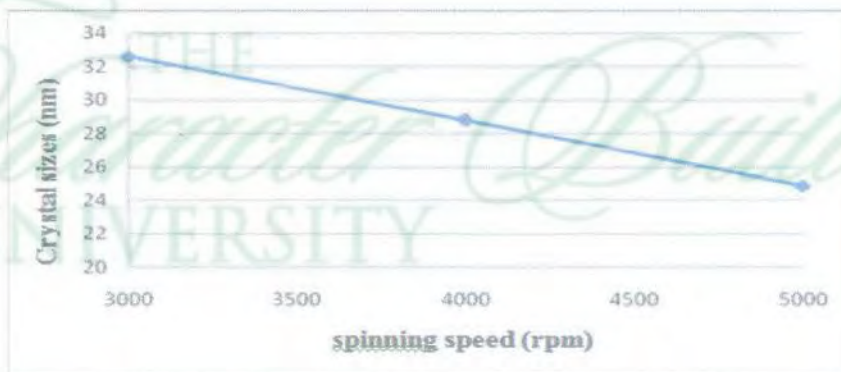


Figure 2. The effect of spinning speed on crystal size.

Figure 2 shows the effect of spinning speed on crystal size. The crystal size decreasing with the increase of the spinning speed. The crystal size is shown by the value of *FWHM* (Full width Half Maximum) or the width of XRD spectrum. The smaller the value of *FWHM* the smaller is the crystal size as shown in Figure 3. In the proses of coating the ZnO thin film the spinning velocity effected by it's centrifugal force in the spreading of the solution on the substrate surface that forms the ZnO thin film. The bigger the centrifugal force in the growth of the thin film, the bigger is the the *FWHM* value and therefore the smaller is the crystal size? Which improves the crytal quality. Previous results show that the higher the the spinning speed the smaller are the crystal sizes [17,18]. However, [19] found that from three variation of speeds (300, 400, and 500 rpm), the smaller crystal size is atthe spinning speed of 400 rpm.

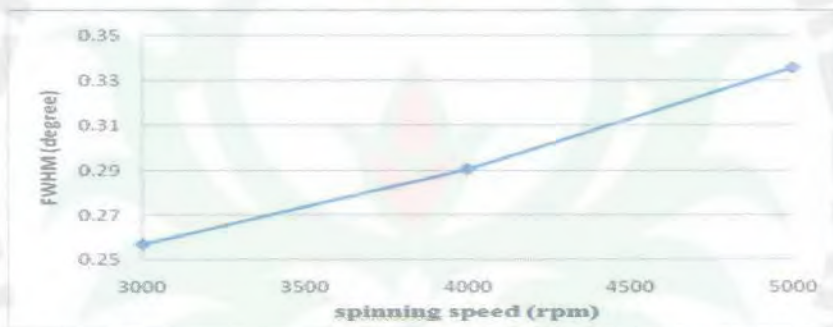


Figure 3. The effect of spinning speed on the value of the *FWHM*

3.2. Optical properties at the ZnO thin film

The transmission and absorption spectrum of the ZnO thin film with spinning speed variations using UV-Vis spectrometer is given in Fig. 4 and 5.

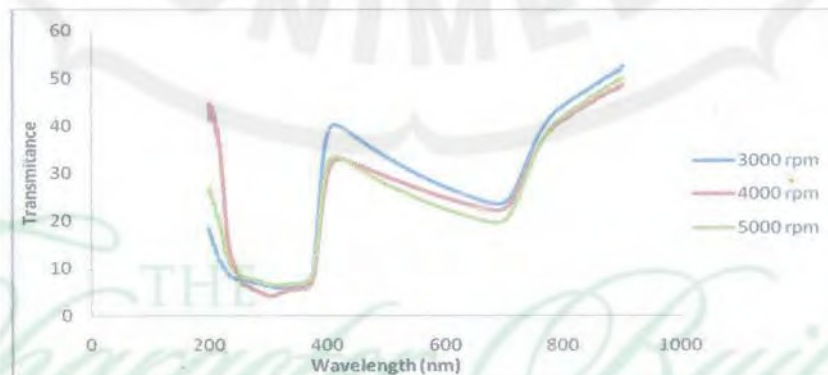


Figure 4. The transmission spectrum of a sample with spinning speed variation of 3000, 4000 dan 5000 rpm

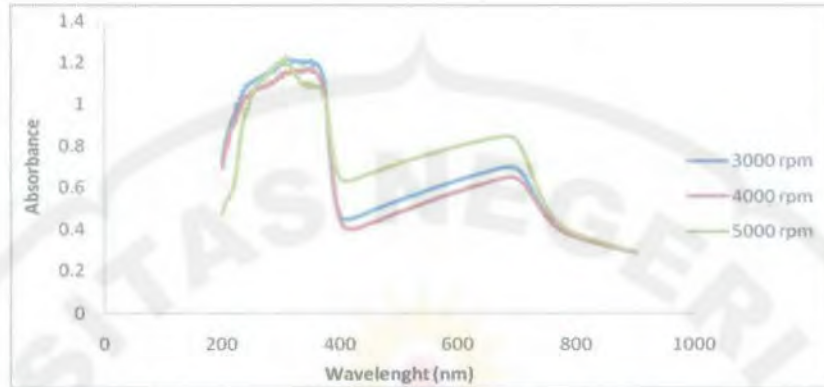


Figure 5. The absorbance spectrum of sample with spinning speed variation of 3000, 4000 dan 5000 rpm.

The transmittance and absorbance spectrum curves of samples with spinning speed of 3000, 4000 and 5000 rpm are figure 4 and 5. The transmission spectrum is opposite of absorption spectrum. The sharp increase in transmission spectrum and the sharp decrease in absorption spectrum takes place at the wavelength range from 350 nm to 400 nm and stable at the wavelength < 350 nm which is at the ultraviolet wavelength region. At the wavelength of 200- 900 nm the lowest and the highest transmission are: (5.8%; 52.6%), (4.1%; 48.6%) and (6.3%; 50.1%) and the lowest and the highest adsorbtion are: (0.719; 1.219), (0.285; 1.172) and (0.291; 1.277).

At the wavelength of 400 nm the the highest and the lowest transmission of the ZnO thin film are consecutively at the spinning speed of 3000 rpm and 5000 rpm. These results show that the increase in spinning speed along with the falling of transmission value agrees with speed mechanism, where the increase of the spinning speed will increase the centrifugal force which at the end affects the transmission and adsorption value of the ZnO thin film [17,20].

The coefficient absorption of direct band gap material is given by the following equation [21]:

$$(\alpha h\nu)^2 = C_D (h\nu - E_{opt}) \quad (4)$$

Where : α is the optical absorption coefficient, h is Planck constant, ν is photon frequency, C_D is a constant, and E_{opt} is the band gap of the sample. The band gap of some variation of spinning velocities of ZnO thin film are given in figure 6. They are shown by the gradient of the fitting lines. The band gap values are given in table 2.

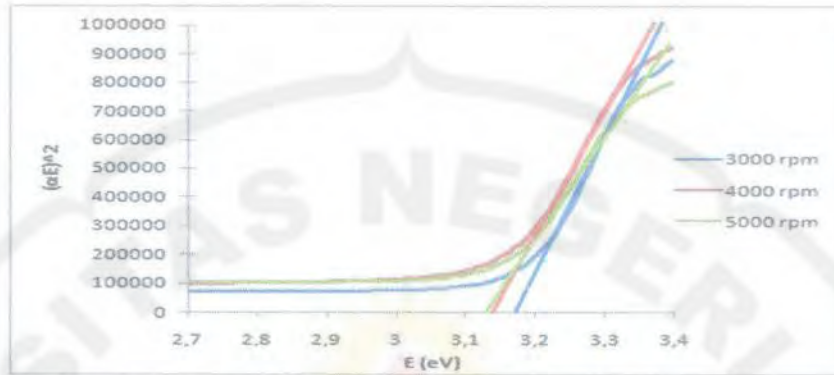


Figure 6. The $(\alpha h\nu)^2$ curves as function of band gap due to variation of spinning velocities.

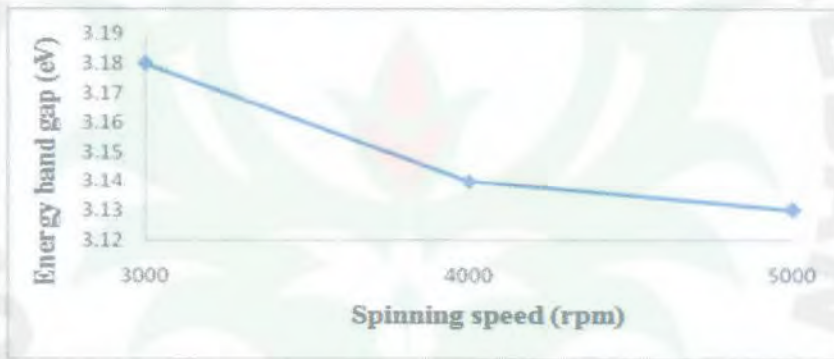


Figure 7. The effect of spinning speed on band gap.

The effect of spinning speed on band gap is given in figure 7. The graph shows that the band gap decreases as the spinning velocity increases. This difference may be due to the different thickness of the film. When the spinning velocity increases, the centrifugal force also increases and therefore will be more spreading and more homogenous but the growth of the film becomes slower. It was found that the increase in spinning velocity, the increase in band gap [17,22] and [20] found that the smallest band gap is at the spinning velocity of 5000 rpm.

4. CONCLUSION

ZnO thin film has been synthesized by spinning coating Sol-gel method using reflux technique on a surface of a glass substrate by varying the spinning velocity. The spinning velocities are 3000, 4000 and 5000 rpm. The crystal structure is hexagonal with the smallest size is 24.9 nm at the spinning velocity of 5000 rpm. The highest transmittance is 52.6 % at the spinning velocity of 3000 rpm and the lowest band gap is 3.13 eV at the spinning speed of 5000 rpm.

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