IADR GENERAL® SESSION

SEOUL, REPUBLIC OF KOREA • JUNE 22-25, 2016

94th General Session & Exhibition of the IADR
3rd Meeting of the IADR Asia Pacific Region
35th Annual Meeting of the IADR Korean Division

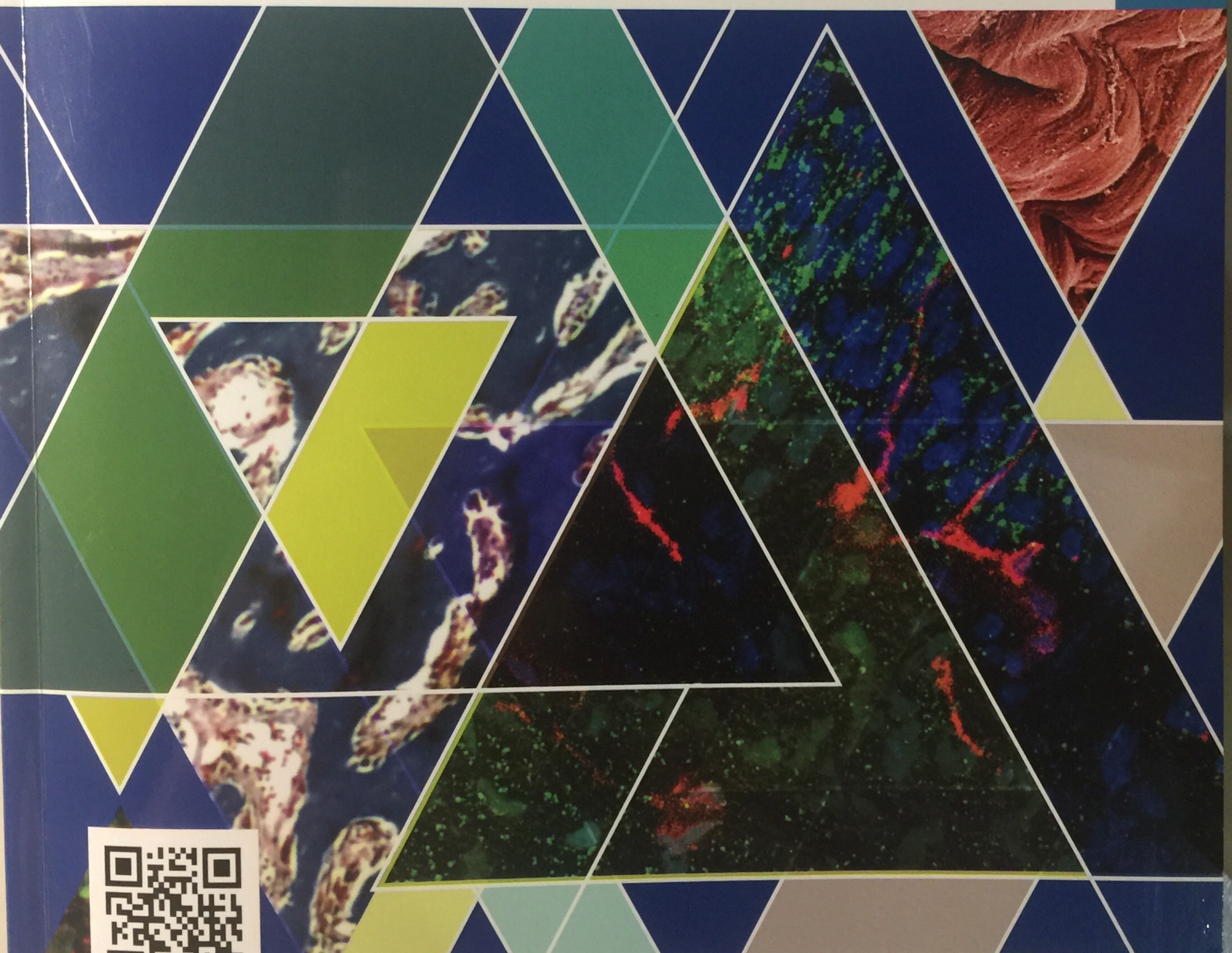
COEX Convention & Exhibition Center
Seoul, Republic of Korea

KOREA TOURISM ORGANIZATION

SEOUL METROPOLITAN GOVERNMENT

www.iadr.org/iags

PROGRAM BOOK



IADR 2016 Meeting App
www.iadr.org/2016app

Complimentary WiFi
Access ID: iadr2016
Password: iadr

#IADR2016

TABLE OF CONTENTS

ADVERTISERS INDEX

 Access ID: **iadr2016** Password: **iadr**

SI101 Powder/Liquid Ratio Effects on Mechanical Properties of Modified β-TCP Cement. Y. IDA*, J. BAE, K. SEKINE, F. KAWANO, K. HAMADA (Tokushima Unuversity, Tokushima, Japan)

EI102 Microstructure Analysis and Hardness Test of Geopolymer Based Nano-Composite Materials. A. EVELYNA*, I. SURYATMOJO, I. ESSYTA, B. SUNENDAR PURWASASMITA (Dental Material, Faculty of Dentistry, Maranatha Christian University, Bandung, West Java, Indonesia)

Seq#: 167 Friday, 24 June 2016, 2 p.m. – 3:15 p.m.
Poster Session, Hall B

Dental Materials 4: Adhesion – *Universal Adhesives & Dentin Treatments in Adhesive Dentistry*

CI103 Application of Ethanol Wet-bonding in the Resin Restoration on Pulpless Permanent Teeth. Z. JIE* (Out-patient Center, Peking University School and Hospital of Stomatology, Beijing, China)

I104 Effect of Different Cross-Linkers on Dentin MMPs. L. BRESCHI*, V. ANGELONI, C. MAZZITELLI, M. CADENARO, L. TJADERHANE, F. TAY, D. PASHLEY, A. MAZZONI (Department of Medical Sciences, University of Bologna, Trieste, Italy)

SI105 Effect of Different Aging Methods and Ethanol Wetting on Microtensile Bond Strength of a Self-etch Adhesive. Y. SESEN USLU*, S. HERGUNER SISO, N. DONMEZ (RESTORATIVE DENTISTRY, BEZMIALEM VAKIF UNIVERSITY, ISTANBUL, FATIH, Turkey)

CI106 Effect of MDP on Enamel Bonding Durability of Self-etch Adhesives. T. TAKAMIZAWA*, K. TSUCHIYA, Y. HOSOYA, W. BARKMEIER, K. TSUBOTA, A. TSUJIMOTO, M. LATTA, M. MIYAZAKI (Operative Dentistry, Nihon University, Tokyo, Japan)

I107 Enhanced Dentin Bonding Stability Using Blue-Light Activated Riboflavin. S.-F. CHUANG*, J.-P. HSIEH, Y.-L. CHEN (Institute of Oral Medicine, National Cheng Kung University, Tainan, Taiwan)

SI108 SEM Analysis: UVA-activated Riboflavin Cross-link to Sound and Caries-affected Dentin. Y. AHN*, R. LAMY, C. DARLING, J. STEWART, L. PINZON (School of Dentistry, University of California, San Francisco, San Francisco, California, USA)

I109 Effect of DCC on Immediate Bond Strength. A. MAZZONI*, V. ANGELONI, V. CHECCHI, R. DI LENARDA, N. SCOTTI, F. TAY, D. PASHLEY, L. BRESCHI (Clinica Odontostomatologica, University of Trieste, Trieste, Italy)

SEI110 Bond Strength of a Universal Adhesive with Different Application Protocols. P. SAIKAEW*, H. SANO, A.F.M. CHOWDHURY (School of Dentistry, Hokkaido University, Sapporo, Japan)

SI111 Bond Strength of Multi-mode Adhesives to Dentin: Systematic Review and Meta-analysis. A. ELKAFFAS*, H. HAMAMA, S. MAHMOUD (Operative Dentistry, Faculty of Dentistry, Mansoura University, Mansoura, Egypt)

SI112 Effects of Dentin Wetness and pH of Universal Adhesives on Dentin Bond Strength. A. CHOI*, S.-A. SON, J.-K. PARK, J. LEE (Conservative dentistry, Pusan national university, Yangsan, Kyungnam, Korea (the Republic of))

CI113 The Evaluation of New All-in-one Self-etching Adhesives. T. HOSHIKA, Y. NISHITANI*, K. TAKAHASHI, T. KAJIHARA, M. YOSHIYAMA (Restorative Dentistry and Endodontology, Kagoshima University, Kagosgika, Kagoshima, Japan)

I114 Influence of Air-powder Polishing on Shear Bond Strength of Universal Adhesive Systems. Y. TAMURA*, S. SHIBASAKI, K. TSUBOTA, T. TAKAMIZAWA, H. KUROKAWA, M. MIYAZAKI, K. HINOURA (Operative Dentistry, Nihon University School of Dentistry, Tokyo, Japan)

SCI115 Adhesive Layer Thickness Of Universal Adhesives And Effect Of Air-thinning. K. CHO*, S.-H. PARK (Department of conservative dentistry, Inha University Hospital, Incheon, Korea (the Republic of))

CI116 Comparison of Mode of Failure of New Universal Adhesives. M.T. PULIDO*, A. TANG, E. WIESNER, J. MITCHELL (College of Dental Medicine, Midwestern University, Glendale, Arizona, USA)

CI117 Influence of Evaporation Time on Hydrophilicity of Different Universal Adhesives. A. MATSUMOTO, A. KASTRATI, R. HAMBURG, W. LOH, M. LECHMANN-DORN*, J. SCHWEPPE, A. LEYER (Heraeus Kulzer GmbH, Hanau, Germany)

I118 Dentin Etching Effects on Microshear Bond Strength of Universal Adhesives. X. HU*, H. ZHANG, J. SORENSEN, A. SADR (Restorative Dentistry, University of Washington School of Dentistry, Seattle, Washington, USA)

I119 Evolution of Recent Universal Adhesives – Chemistry and Performance. C. THALACKER*, H. LOLL, I. EDELMANN, R. GUGGENBERGER, B. KIM (3M Oral Care, 3M Deutschland GmbH, Seefeld, Bavaria, Germany)

I120 Immediate Microtensile Bond Strength Evaluation of Universal Adhesives. N. SIRINSUKAN*, E. CAN SAY (Department of Restorative Dentistry, Yeditepe University, Istanbul, Turkey)

SI121 Dentin Bonding in Physicochemical Properties of Adhesives Incorporated With Epigallocatechin-3-gallate. A. DE MACEDO*, M. LEMOS, N. SOUZA, V. FEITOSA, S. SANTIAGO (Restorative Dentistry, Federal University of Ceara, Fortaleza, Ceara, Brazil)

I122 Effect of Previous Acid Etching and Application Mode on Enamel Bonding Durability of Self-etch Adhesives. K. TSUBOTA*, T. TAKAMIZAWA, A. TSUJIMOTO, M. MIYAZAKI, M. LATTA (School of Dentistry, Nihon University, Tokyo, Japan)

Seq#: 168 Friday, 24 June 2016, 2 p.m. – 3:15 p.m.
Poster Session, Hall B

Dental Materials 5: Biocompatibility and Biologic Effects of Materials – *Antimicrobial Effects of Dental Materials*

I123 Synthesis and Characterization of a Novel Antibacterial and Bioactive Root Canal Sealer Precursor. X. CHENG, T.-J. QU, Q. YU, X. LIU* (Baylor College of Dentistry, Dallas, Texas, USA)

CI124 Biofilm Formation on Dental Restorative Biomaterials. S. DENG*, D. CHAN, K.-H. CHUNG, R. FRANCISCO, J. BRYERS (Department of Conservative Dentistry, Affiliated Hospital of Stomatology, Zhejiang University, Hangzhou, Zhejiang, China)

I125 Antibacterial Activity of Dental Restorative Materials Containing Urushiol Extracts From the Korean lacquer Tree. H. MOON, D.-H. SHIN* (College of Dentistry, Dankook University, Chunan, Choong-Nam,

SEI126 Surface Property Changes of Titanium After Bacterial Inoculation and Debridement. G.-S. SH[illegible], B.-S. LEE, Y.-W. CHEN (National Taiwan University, Taipei, Taiwan)

Research Reports

SYNTHESIS AND MICROSTRUCTURE ANALYSIS of Al-Mg-Si-Zr GEOPOLYMER BASED NANO-COMPOSITE FOR DENTAL MATERIALS APPLICATION

Angela Evelyna[1], Ibnu Suryatmojo[1], Ingge Essyta[1]
Bambang Sunendar Purwasasmita[2]

[1]Dental Materials Department, Faculty of Dentistry,
Maranatha Christian University, Bandung, Indonesia
[2]Physics Engineering, Advanced Material Processing Laboratory,
Faculty of Industrial Technology,
Institut Teknologi Bandung, Indonesia

Abstract.

Science and technology of dental materials development provides variety of dental products that fulfils the needs of aesthetics and physical properties. There are wide ranges of aesthetics dental materials, one of them is dental composite. The use of inorganic ceramic nanoparticle filler on dental composite system has provides many advantages. However it have severals limitations due the use of polymer resins as matrix such as a low mechanical property. To overcome the problem, geoplymer nanocomposite materials of Al-Mg-Si-Zr used to substutute resin polymer. Geoplymer materials have reliable properties such as low density, easily processed, and low cost.

The objective of this study is to synthesis four different types of inorganic ceramic fillers, alumina, magnesia, silica, and zirconia using sol-gel tecnique, with two differents alkali activator concentrations (8 M and 12 M) and then coorporate them with geopolymer as matrix to characterized its microstructure through XRD and SEM to know the phase characterization, crystal structure, and size.

The X-Ray Diffraction and Scanning Electron Microscopes Characterized that, Al-Mg-Si-Zr have been formed with nano sized particles. Microscopic morphology of Mg-Al-Si-Zr

nanocomposite with alkali activator concentration 8 M has more porosity than 12 M that lead to better mechanical property.

Keywords: Al-Mg, Si, Zr, geopolymer, nanocomposite, dental materials

INTRODUCTION:

Individual or community oral health is the key to achieve a good quality of life. Most of Indonesian people have known oral health educations and get the access to oral health services. But somehow, the optimal health service could only perceived by the middle-high economic group of the community. This happens because inability of dental manufacturer in Indonesia to produce variety dental products with good quality, therefor most of dental material products are still imported from the other country, which results in high cost of dental health services. Dental parctice could not be seperated from the use of various dental materials to suport dental health care and therapy. One of the mostly used dental materials are dental composites. [1,2]

Generally, composites are combination of two or more different materials to get a better property. Dental composite is a restorative resin material that consists of inorganic fillers such as amorphous silica, glass, and crystalline materials that combine with organic matrix resins by the use of coupling agent. Most of dental composite contains synthetic resin matrix to increase binding properties between polymers and fillers. The matrix resins that being used are aliphaticdimethacrylate monomer (bis-GMA), triethylene glycol dimethacrylate (TEGDMA), and urethane dimethacrylate (UDMA). Synthetic resins have a low physical and mechanical property. [3]

Geopolymer is an inorganic polymer material, can be activated by silica-alumunium rich mineral. Geopolymerization occur through complex exotermis process. Geopolymer beginning to be liked and improved because its excellent physical and mechanical properties, compared with synthetic polymer resin. Geopolymeric materials can be used on extremely high temperature condition, it can reach 1000 °C. The firing gas product is not combustible and poisonous. [4,5]

Addition of nano-particle ceramic filler material has been much used in the process of making dental composite material restoration. Ceramic filler material which been used is alumina (Al_2O_3) because of its crack propagation resistention and good thermal expansion coefficient. Magnesium Chlorida (MgCl) been used as alumina stabilizer. Silica (SiO_2) has good strength and esthetic. Zirconia (ZrO_2) is an inert material and has good fracture toughnes. All of the four kind ceramic fillers are nano-sized powder blend by optimal proportioning weight percentation then combined with polymer matrix through the use of coupling agent to make nano composite material. Coupling agent is a substance applied at the surface of filler particle to create ahesivity between fillers and matrix. Chitosan is a kind of organic polymer made from sea creatures shells such as crustacea. Chitosan can be used as a coupling agent because its adhesivity to ceramic materials. Chitosan has been widely used as biomaterials. [6-9]

Nanotecnology has led us to improvement of biomaterials engineering. Nanosixed is the smallest size that can be reach by synthesis method existed untill now. The smaller the particle size, the more filler particles can be inserted to the composite, so the better mechanical property can be reach. One technique that has been choosed to synthesize ceramics nanoparticles is sol-gel technique (precursor) that mainly involved two processes, hydrolysis and condensation. This technique was widely chosen because it is more efficient and cheaper, it only requires some relatively simple instruments compared with other technique. Inorganic ceramic nanoparticles fillers can be synthesized using sol-gel technique. [10]

This study attempts to synthesize nanocomposite base geopolymer alumina-silica-magnesia-zirconia materials for dentistry application and characterized its microstructure.

MATERIALS AND METHODS

MATERIALS

Materials used in this research are $MgCl_2$, Tetraethyl-orthosilicate (TEOS), $Al(NO_3)_3$, $ZrCl_4$ as precursors, Chitosan as coupling agent, a solvent of demineralization aqua liquid (Aqua DM), crystalline NaOH and waterglass/ sodium silicate (Na_2SiO_3).

METHODS

This study is a pure laboratory experimental research study. Sample used in this study are Mg-Al-Zr-Si nanocomposite bars with different mass fraction and activator alkali with different molarity to see morphological characteristics.

The research prosedure divided into several stages. The first stage is producing NaOH solution, followed by making alkaline activator solutions and 2% Chitosan solution. Mg-Al-Si-Zr prepared bu using sol-gel methods. The last stage is to characterized its microstructure and filler distribution by x-ray diffraction (XRD) and scanning electrone microscope (SEM) analysis to analyze the phase and structure of crystal lattice by using philips analytical x-ray B.V, diftactometry type PW1710 and the scanning electrone microscopy (SEM) JSM 6510 LV. [11,12]

RESULTS AND DISCUSSION

The Mg-Al-Si-Zr geopolymer based nanocomposite by firing temperature of 800 °C XRD characterization results shows difractogram as follow (fig. 1).

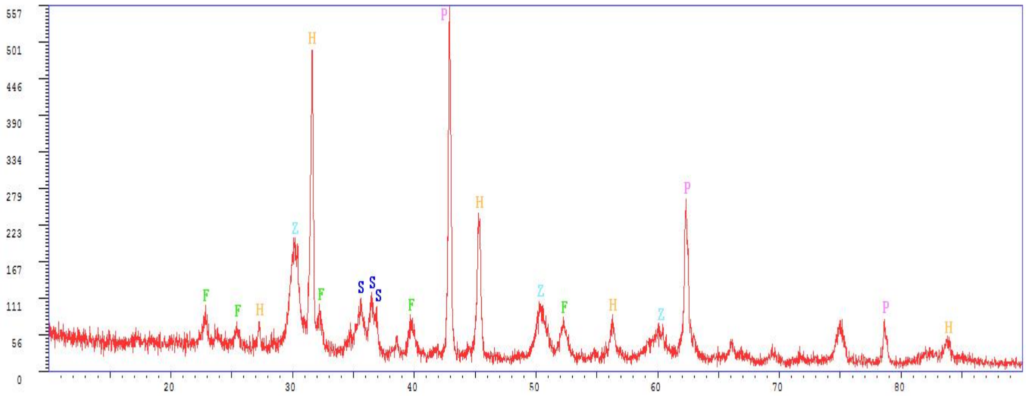


Figure 1. Difractogram of Mg-Al-Si-Zr powder

Synthesize product difractogram compared with diffraction pattern from Joint Committee on Powder Diffraction Standard (JCPDS) to determine which crystal lattice formed.

Diffractogram results analyzed using xpowder software in order to obain information about crystal lattice. Crystalline phase of MgAlO4 spinel (JCPDS no. 21152) have been successfully synthesize, shown with the emergence of diffraction pattern at 37° peak. $MgAlO_4$ spinell fractions produced were still to view (8.2 %). This could be happen because the calcination temperature has not steady yet. ZrO_2 phase (JCPDS no. 270997) indicate by diffraction patterns at 30°, 50° and 60° peak. Beside those compounds there are also another compound such as MgO periclase (JCPDS no. 450946), Mg2SiO4 forsterite (JCPDS no. 340189), and NaCl halite (JCPDS no. 050628). MgO periclase shown by 43°, 62° and 79° diffractions peak. Mg_2SiO_4 forsterite shown by 23°, 25°, 32.5°, 40° and 52° diffractions peak. NaCl halite shown by 27.5°, 31.5°, 25.5° and 56.5° diffractions peak.

SEM figure of Mg-Al-Si-Zr nanocomposite with 6:2:1:1 filler proportion and alkaline activator concentration addition of 8M and 12M at 500, 1.000, and 2.500 magnifying shows patterns as bellow.

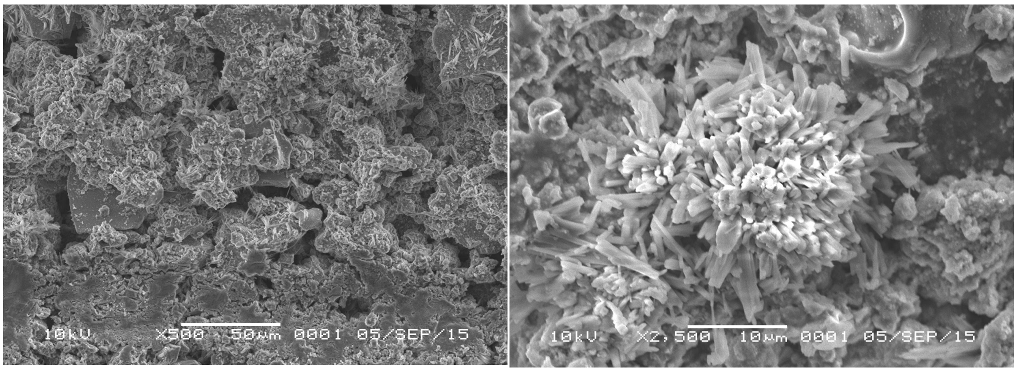


Figure 2. SEM Figure of Alkaline Activator 8M (500x and 2500x)

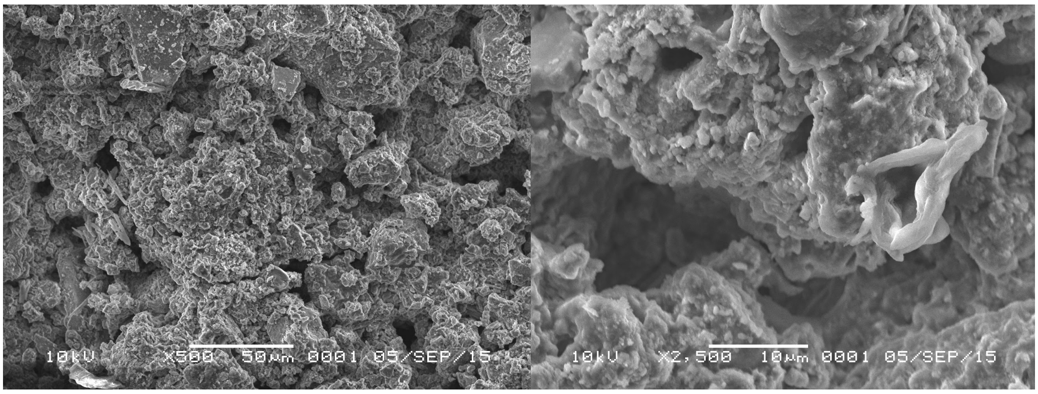


Figure 3. SEM Figure of Alkaline Activator 12M (500x and 2500x)

SEM characterization figures shows, Mg-Al-Si-Zr nanocomposite with 8 M concentration is more homogeneous compared with Mg-Al-Si-Zr nanocomposite with 12 M concentration. This can be seen from figure 2 where fillers are equally distributed, there are only few tufts (agglomerations) and pores compared to figure 3, which is more globules and fillers are not distributed equally and homogeneous.

Therefore, Mg-Al-Si-Zr nanocomposite with 8 M alkaline activator concentration has a better mechanical properties compared with 12 M. SEM figures also shows rods morphology at figure 3 which may results from silica particles. Silica filler particles of Mg-Al-Si-Zr nanocomposite 12 M are not shown so much, which can lead better bonding ability between silica filler and geopolymer matrix, however there are more cracks on Mg-Al-Si-Zr nanocomposite 12 M so the mechanical properties are lower.

CONCLUSION

Mg-Al-Si-Zr nanocomposite has been successfully synthesized using sol-gel method through calcination process at 800 °C for two hours and formed MgAlO4 spinell (JCPDS no. 21152) crystal lattice, but the spinell fractions are still too few.

SEM characterization shows Mg-Al-Si-Zr nanocomposite with 8 M alkaline activator concentration looks more homogeneous compared to 12 M. So it can be concluded that the mechanical properties of 8 M possibly better than 12 M.

REFERENCES

1. Dewi, Ni K.S.S. Pengaruh Aksesibilitas Terhadap Kepuasan Pasien di Rumah Sakiy Gigi dan Mulut Fakultas Kedokteran Gigi Universitas Mahasaraswati Denpasar. Fakultas Kedokteran Gigi Universitas Mahasaraswati Denpasar; 2014: 1-4.
2. Chuanda. C, dkk. Gambaran Kepuasan Pelayanan Perawatan Gigi Tiruan Lepasan Berbasis Akrilik Pada Masyarakat Kelurahan Molas. Skripsi. Program Studi Kedokteran Gigi Fakultas Kedokteran Universitas Sam Ratulangi Manado; 2014: 1-3.
3. Powers, J. M., Ronald L. S. *Craig's Restorative Dental Materials,* 11th Ed. Mosby, St. Louis Missouri; 2002: 399-406.
4. Ghosh. K., Ghosh P. *Effect of Synthesizing Parameters on Compressive Strenght of Flyash Based Geopolymer Paste.* International Journal of Structural and Civil Engineering. India: 2012; 1-9(1)
5. Al Bakri. A. M., et al. *Mechanism and Chemical Reaction of Fly Ash Geopolymer Cement-A review.* Journal of Asian Scientific Research. Malaysia: 2011; 1(5): 247-253.
6. Hakim. F., R.Perlakuan Sintering Suhu Rendah Terhadap Mikrostruktur dari Komposisi Alumina, Zirkonia, Magnesia, Silika dan Kromina untuk Aplikasi Keramik Struktural. *Tugas Akhir*. Program Studi Fisika, Fakultas Teknologi Bandung, Bandung; 2012.
7. Ayu. E., T. Pengaruh Kitosan Terhadap Diversifikasi Partikel dari Serbuk Nanokomposit (ZrO2-Al2O3-SiO3-*whitelocked*) dalam Memperbaiki Sifat Mekanik Pada Restorasi Gigi Direk, *Tesis*. Institut Teknologi Bandung. Bandung; 2011.
8. Antonnuci. J. M., dkk. *Chemistry of Silanes: Interfaces in Dental Polymers and Composite.* Journal of Research of the National Institute of Standards and Technology; 2005; 110: 541-558.
9. Lestari. G. M. *Sintesis Calcium Phosphate Cement dengan Modifikasi Tetracalcium Phosphate dan Dicalcium Phosphate dengan Chitosan sebagai Gelling Agent.* Tugas

Akhir Sarjana. Program Studi Teknik Material Fakultas Teknik Mesin dan Dirgantara. Institut Teknologi Bandung; 2009: 16-18.

10. Kurniawan. A, Purwasasmita. B. S., & Arief. C. *Synthesis and Characterization Nanocomposite Hydroxyapatite-Zirkonia-Alumina-Silica with Pulp Acacia Mangium as Template Via Precursor Process Method.* Material Engineering Department Faculty of Industrial Technology. ITB; 2009; 13-15.
11. Chevile. A. *The Scanning Electron Microscope.* Electrical Engineering. Oklahoma State University; 2009.
12. Callister, W.D. Material Science and Engineering : An Introduction. 7th ed. USA : John Willey & Sons; 2007: 440-1, 66-70