7th Hiroshima Conference on Education and Science in Dentistry

Hiroshima University
BioDental
Education and Research

"Diversity in Oral Science Research"

Itsukushima Shrine: Bugaku dancer (Court dance and music)
Photo Courtesy of Hiroshima Prefecture

Hiroshima University School of Dentistry

7th Hiroshima Conference on Education and Science in Dentistry

Program & Abstracts of 7th Hiroshima Conference on Education and Science in Dentistry
March 29-30, 2018, Hiroshima, Japan

Hiroshima University School of Dentistry

Time table

Thursday, March 29, 2018

		12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00
Registration	1F:Entrance	12:00～17:50 Registration								
Cloak	1F:Small Conference Room	12:00～17:50 Cloak								
Conference Program	2F:Large Conference Room		13:00 ～ 13:10 Opening	13:10～14:10 Special Lecture	14:10～15:50 Session Ⅰ : Joint degree, Sandwich program	15:50～16:30 Coffee Break and Adjustment Time	16:30～17:50 Young Investigator Session Ⅰ			
Poster Exhibition	2F:Medium Conference Room	12:00～13:00 Poster Preparation	13:00～17:30 Poster Exhibition			15:50～16:30 Poster Discussion	Poster Exhibition			
Reception	VIOLA Dining							17:50～18:30 Registration	18:30～20:00 Welcome Reception	

Friday, March 30, 2018

		8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00
Registration	1F:Entrance	8:30～17:00 Registration									
Cloak	1F:Small Conference Room	8:30～17:00 Cloak									
Conference Program	2F:Large Conference Room		9:00～10:30 Session Ⅱ : Advanced Imaging	10:30～12:00 Session Ⅲ : Application of Advanced Engineering Technologies		12:00～13:15 Luncheon Seminar	13:15～14:45 Session Ⅳ : New Insights into Extracellular Vesicle Biology	14:45～15:20 Coffee Break and Adjustment Time Group Photo	15:20～16:40 Young Investigator Session Ⅱ	16:40 ～ 17:00 Closing	
Poster Exhibition	2F:Medium Conference Room		9:00～16:40 Poster Exhibition					14:45～15:20 Poster Discussion	Poster Exhibition		

※Venues
Conference : KOUJIN Conference Hall on Kasumi Campus, Hiroshima University
Welcome Reception : VIOLA Dining, Kasumi Campus Hiroshima University

Contents

F-9 Synthesis and Microstructure Analysis of Graphene Oxide for Dental Materials Applications

Angela Evelyna[1], Anastasia Alamanda Chakravitha[2], Stefani Kartika Putri[2], Tolistya Novitasari Abdullah[2], Idham Pribadi Mochammad[2] and Bambang Sunendar Purwasasmita[3]

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BACKGROUND : Dental composite resin is one of the most commonly used restoration materials in dentistry that fulfils the needs of aesthetics and physical properties. The use of inorganic ceramic nanoparticle filler on dental composite system has provides many advantages. One of the substances that has possibility to enhance mechanical properties of resin composite material is graphene oxide. Graphene oxide is a derivative from graphene, allotrope of carbon. It has been found to increase mechanical properties such as tensile strength, hardness, wear resistance, durability, and fracture strength. Graphene oxide is also assumed to have antibacterial properties, yet is not toxic for human body.

OBJECTIVES : The objective of this study is to synthesis graphene oxide from graphite and characterized its microstructure through X-Ray Diffraction (XRD) and Fourier Transform Infrared Spectrometer (FTIR).

MATERIALS & METHODS : Graphene oxide was synthesis from graphite using modified hummers method. XRD was selected to measure the crystal structure of graphene oxide. FTIR was used to certify the presence of oxygen containing functional groups of graphene oxide.

RESULTS : In XRD pattern, graphene oxide shows a characteristic peak at $2\theta = 11.49°$ which shows main characteristic of graphene oxide. FTIR pattern shows the peak at 1068 cm-1 confirms the presence of C-O functional groups.

CONCLUSION : The XRD and FTIR Characterized that, graphene oxide have been formed using modified Hummers method.

Key words : Graphene oxide, nanocomposite, dental materials, XRD, FTIR

Poster Presentation

F-10 Incremental Technique on Bulk Fill Composite Resin to Reduce Microleakage in Deep Cavity

Maria Andisa Mayangsari[1], M. Mudjiono[2] and Nanik Zubaidah[2]

[1] Undergraduate student, Faculty of Dental Medicine Universitas Airlangga
[2] Lecturer, Department of Conservative Dentistry, Faculty of Dental Medicine, Universitas Airlangga

BACKGROUND : Composite resin remains as one of the most popular restorative material in dentistry. However, polymerization shrinkage is one major drawback of composite resin, especially methacrylate-based composite resin. Polymerization shrinkage can lead to microleakage and may affect the occurence of secondary caries. In deep cavity, there are 3 major challenges to create a durable restoration: limited depth of cure, shrinkage, and manipulation of proximal contact to adjacent tooth. Incremental placement technique has been widely suggested as an attempt to minimize polymerization shrinkage. Meanwhile, development in dental material has brought us bulk fill composite resin that indicated for direct restoration up to 4 mm thickness with less polymerization shrinkage compared with conventional composites. The combination of incremental technique and bulk fill composite resin can be a time-saving option for restoration of deep cavities.

OBJECTIVE : This study aimed to investigate the microleakage difference between bulk and incremental technique on bulk fill composite resin.

MATERIALS & METHODS : Samples were 24 human premolars and divided into two groups (group 1 and group 2). Cavity of 4 mm depth with 2 mm diameter was made on every sample. Group 1 used bulk technique composite resin placement (4 mm) and group 2 used the placement technique of incremental 2 layers (each 2 mm) horizontally. The entire samples were immersed in 0.3% methylene blue for 24 hours. Samples were cut in bucco-lingual direction and captured into images using digital microscope. Dye penetration was measured for each sample to semi-quantitatively determine the microleakage according to scoring method. Data were analyzed using Mann-Whitney Test.

RESULTS : There were significant differences between sample groups with p value 0.012 ($p < 0.05$ considered significant). In general, microleakage in incremental technique is smaller than bulk technique.

CONCLUSION : Incremental technique on bulk fill resin composite restoration successfuly created less microleakage than bulk technique.

Key words : Bulk fill composite, polymerization shrinkage, incremental technique, bulk technique, microleakage

Research Report

Synthesis and Microstructure Analysis of Graphene Oxide for Dental Materials Applications

Angela Evelyna[1], Anastasia Alamanda Chakravitha[1], Stefani Kartika Putri[1], Tolistya Novitasari Abdullah[1], Idham Pribadi Mochamad[1], and Bambang Sunendar Purwasasmita[2]

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ABSTRACT

Background: Dental composite resin is one of the most commonly used restoration materials in dentistry that fulfils the needs of aesthetics and physical properties. The use of inorganic ceramic nanoparticle filler on dental composite system has provides many advantages. One of the substances that has possibility to enhance mechanical properties of resin composite material is graphene oxide. Graphene oxide is a derivate from graphene, allotrope of carbon. It has been found to increase mechanical properties such as tensile strength, hardness, wear resistance, durability, and fracture strength. Graphene oxide is also assumed to have antibacterial property, is not toxic for human body. **Objectives:** The objective of this study is to synthesis graphene oxide from graphite and characterized its microstructure through X-Ray Diffraction (XRD) and Fourier Transform Infrared Spectrometer (FTIR). **Methods:** Graphene oxide was synthesis from graphite using modified hummers method. XRD was selected to measure the crystal structure of graphene oxide. FTIR was used to certify the presence of oxygen containing functional groups of graphene oxide. **Results**: In XRD pattern, graphene oxide shows a characteristic peak at $2\theta = 11.49°$ which shows main characteristic of graphene oxide. FTIR pattern shows the peak at 1068 cm-1 confirms the presence of C-O functional groups. **Conclusion:** The XRD and FTIR Characterized that, graphene oxide has been formed using modified Hummers method.

Key words: Graphene oxide, nanocomposite, dental materials, XRD, FTIR.

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INTRODUCTION

Graphene oxide (GO) is a graphite oxidation exfoliation product that can potentially reinforced dental nanocomposite. Graphene oxide has the same hexagonal crystal structure as graphene. Fracture strength of graphene oxide (63 GPa) is not as high as graphene (1 TPa) but it can potentially use as dental restoration additive filler because if its biocompatibility nature such as, non-toxic property and lower thermal conductivity. Based on toxicity study on tooth follicle stem cell, GO proved to be less toxic compare to reduced graphene oxide and nitrogen-doped graphene. [1-3]

Good mechanical property is one of dental materials requirements beside having esthetic appearance, non-toxic behavior, doesn't irritate oral tissue, and having natural adhesivity to tooth structure. [4]

Dental composite is one of dental restorative material that meet almost all the requirements needed for ideal tooth restoration. Unfortunately, it has lack mechanical properties because the resin base matrix. Mechanical properties increase as filler loading increase. Types of dental composite filler such as quartz, silica, glass or heavy metal ceramics are used. But it still doesn't meet the expectancy of high mechanical properties of dental materials. [4,5]

The use of graphene oxide as one of dental composite filler additive worth to study. Graphene oxide powder synthesized from graphite through Modifies Hummer's can increase mechanical properties such as compressive strength, flexural strength, tensile strength, Young modulus, wear resistance, and also hardness of resin composite. [1, 6, 7]

Picture 1. Schematic Figure of Oxidation from Graphite to Graphene Oxide [8]

Microstructure analysis is very important for gaining data about self-synthesize products. Microstructure analysis tests usually done are X-Ray Diffraction (XRD) and Fourier Infrared Spectroscopy (FTIR). XRD is the most effective method to observe crystal structure of material. Diffraction method can be used to identify crystal structure of chemical mixture not from its chemical contents, it means, different mixture with the same composition can be identified. FTIR is one of infrared spectroscope, a method to characterize and observe interaction between infrared light and object. [9,10]

OBJECTIVES

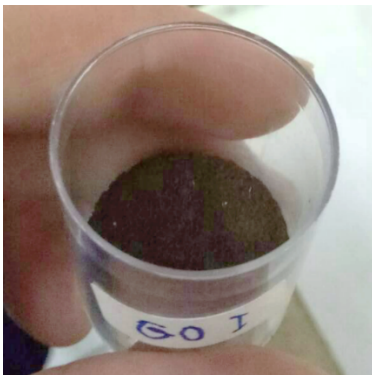
The objective of this study is to synthesize graphene oxide nanoparticle from graphite using modified hummers method and analyze it microstructure using FTIR and X-Ray Diffraction.

MATERIALS AND METHODS

Graphene oxide synthesized from graphite using Modified Hummer's Method as follow. Graphite powder mix with natrium nitrate ($NaNO_3$) and 98% sulfate acid (H_2SO_4). The temperature of mixing volumetric tube kept on 0-5°C in ice bath for four hours. Potassium manganate added slowly and gently to keep the temperature stable on 15°C. [11]

The mixture added by 184 mL water slowly while keep on mixed for two hours. Mixture incorporate to reflux system at 98°C for 10-15 minutes. After 10 minutes lower the temperature to 30°C until it turns brown. After 10 minutes, lower the temperature at 25°C and keep for 2 hours. Add 40 mL H_2O_2 until it turns bright yellow. [11]

Aquades add to the beaker glass and add 200 mL prepared mixture and mix again for 1 hour. Liquid at the bottom of the beaker filtered and centrifuge with aquades for several times. Mixture kept in room temperature for three to four hours without mixing and filtered. Centrifuge with 10% HCl until neutral pH. After gelation, vacuumed at 60°C till form graphene oxide. [11]

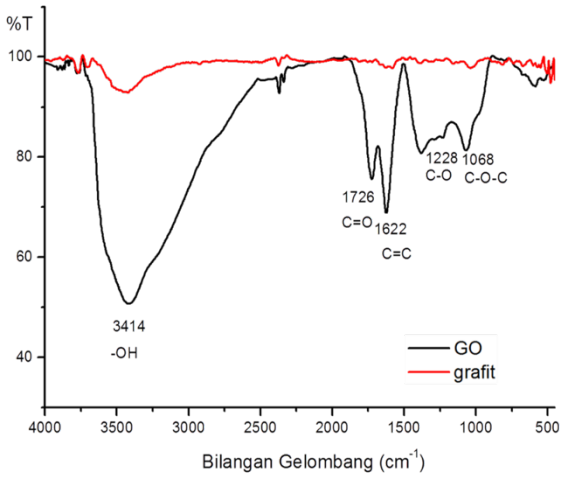


Picture 2. Graphene Oxide Powder

Fourier Infrared Spectroscopy (FTIR) of graphene oxide nanoparticle using Ion Sputter MC1000. X-Ray Diffraction using Philips Analytical X-Ray B.V. PW 1710 to identify its microstructure.

RESULTS

FTIR to graphite and graphene oxide particles shows infrared pattern as can be seen at picture 3.

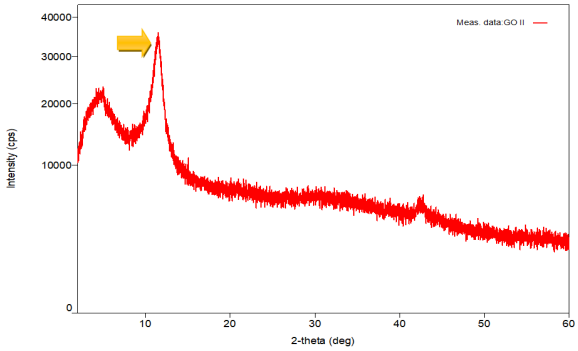


Picture 3. Infrared Spectrum of Graphite and Graphene Oxide (GO)

Graphite and GO infrared spectrum show different peaks. The curve is flat at graphite with

no significant peak of certain functional groups. Different with GO that shows peaks at 3414 cm^{-1}, 1726 cm^{-1}, 1622 cm^{-1}, 1228 cm^{-1} and 1068 cm^{-1}. Peak at 3414 cm^{-1} show O-H bonding stretch from hydroxyl group of GO and absorb water molecule. Peak at 1726 cm^{-1} show C=O bonding stretch from ketone functional group and carboxylate acid of GO. Peak at 1622 cm^{-1} shows C=C bonding stretch from aromatic carbon ring. Peak at 1228 cm^{-1} show C-O bonding stretch from carboxylate acid and alcohol functional groups. Peak at 1068 cm^{-1} show C-O-C bonding from epoxide functional group. Various peak infrared spectrum of graphene oxide show that graphite has been oxidation to GO, so it shows functional group that contain oxygen. [11,12]

XRD characterization show XRD pattern result as picture 4.



Picture 4. XRD Pattern of Graphene Oxide

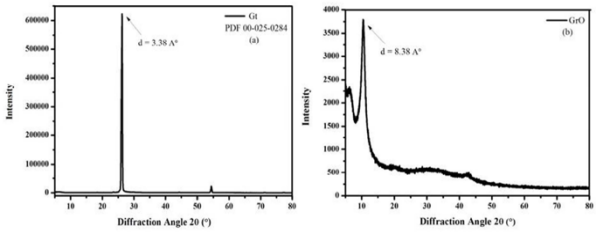
XRD Pattern of Graphene Oxide show highest diffraction peak at 2θ = 11,49°. This result match as literature data referent of GO XRD peak which is 10-12°. This show there is different XRD pattern between graphite that has highest diffraction peak at 2θ = 26°. Highest peak shifting from 26° to 11,49° shows distance addition between aromatic carbon layers when graphite oxidation to GO. Other than peak 2θ = 11,49° there is another peak that lower which is 2θ = 42° that indicate short range order pattern at GO layer. [11,13]

DISCUSSION

Graphene oxide in this study synthesize using Modified Hummer's method with pure graphite powder as raw material. Graphite is a carbon allotrope with honeycomb crystal structure that shows layers without any functional group. After oxidation using Hummer's method, graphite will be separate layer by layer and graphene oxide has several functional groups which are carboxylate acid, alcohol, epoxide, and ketone. [8]

There is slight color difference between graphite and graphene oxide powders. Graphite is black while graphene oxide is dark brown (picture 2). Characterization test in this study using two methods, which are Fourier Infrared Spectroscopy (FTIR) and X-Ray Diffraction. Graphite FTIR result show relatively flat infrared spectrum without any functional group. Otherwise, graphene oxide FTIR result show O-H, C=O, C=C, C-O, and C-O-C bonds that proof hydroxyl, carboxylate, ketone, and epoxide functional groups exist. These groups contain oxygen after graphite oxidation to GO. [12]

X-Ray Diffraction (XRD) at GO powder show highest peak at 2θ = 11,49° that show peak shifting of the highest peak of graphite at 2θ = 26°. This proof distance addition between carbon aromatic layers while graphite oxidation to GO. The comparison between graphite and GO XRD pattern can be seen at picture 5.



Picture 5. Pattern Comparison between Graphite and Graphene Oxide

CONCLUSION

Synthesize of graphene oxide (GO) powder from graphite powder can be done using Modified Hummer's method. This can be seen by Fourier Infrared Spectroscopy (FTIR) and X-Ray Diffraction pattern.

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