DAFTAR PUSTKA

Adetayo, Adeniji dan Damilola Runsewe. 2019. Synthesis and Fabrication of Graphene and Graphene Oxide: A Review. *Journal of Composite Materials*. 9 : 207-229.

Akbari, Ebrahim., Imam Akbari dan Mohammad Reza Ebrahimi. 2019. sp^2/sp^3 bonding ratio dependence of the band-gap in graphene oxide. *The European Physical Journal B*. 92 : 71.

Becerril, H. A., Mao, J., Liu, Z., Stoltenberg, R. M., Bao, Z., & Chen, Y. 2008. Evaluation of Solution-Processed Reduced Graphene Oxide Films as Transparent Conductors. *ACS Nano*. 2(3): 463–470.

Bhaumik, A., Haque, A., Taufique, M., Karnati, P., Patel, R., Nath, M., & Ghosh, K. 2017. Reduced Graphene Oxide Thin Films with Very Large Charge Carrier Mobility Using Pulsed Laser Deposition. *Journal of Material Science & Engineering*. 06(04).

Bhuyan, Sajibul Alam., Nizam Uddin, Maksudul Islam, Ferdaushi Alam Bipasha, Sayed Shafayat Hossain. 2016. Synthesis of graphene. *Int Nano Lett*. 6 : 65-83.

Caer, Shopie Le. 2011. Water Radiolysis: Influence of Oxide Surface on H_2 Production under Ionizing Radiation. *Water*. 3 : 235-253.

Chang, C.-K., Kataria, S., Kuo, C.-C., Ganguly, A., Wang, B.-Y., Hwang, J.-Y., … Chen, K.-H. 2013. Band Gap Engineering of Chemical Vapor Deposited Graphene by in Situ BN Doping. *ACS Nano*. 7(2): 1333–1341.

Chien, C.-T., Hiralal, P., Wang, D.-Y., Huang, I.-S., Chen, C.-C., Chen, C.-W., & Amaratunga, G. A. J. 2015. Graphene-Based Integrated Photovoltaic Energy Harvesting/Storage Device. *Small*. 11(24): 2929–2937.

Coropceanu, V., Cornil, J., da Silva Filho, D. A., Olivier, Y., Silbey, R., & Brédas, J.-L. 2007. Charge Transport in Organic Semiconductors. *Chemical Reviews*, 107(4): 926–952.

Dahoumane, Si Amar., Clayton Jeffryes, Mourad Mechouet dan Spiros N. Agathos. 2017. Biosynthesis of Inorganic Nanoparticles: A Fresh Look at the Control of Shape, Size and Composition. *Bioengineering*. 4 : 14.

Dimiev, A. M., & Tour, J. M. 2014. Mechanism of Graphene Oxide Formation. *ACS Nano*. 8(3): 3060–3068.

Dreyer, D. R., Park, S., Bielawski, C. W., & Ruoff, R. S. 2010. The chemistry of graphene oxide. *Chem. Soc. Rev*. 39(1): 228–240.

Eda, G., Fanchini, G., & Chhowalla, M. 2008. Large-area ultrathin films of reduced graphene oxide as a transparent and flexible electronic material. *Nature Nanotechnology*. 3(5): 270–274.

Egerton, Ray F. 2005. Physical Principles of Electron Microscopy. Springer : Switzerland.

El-Nour, Kholoud M. M. Abou, Ala'a Eftaiha, Abdulrhman Al-Warthan dan Reda A. A. Ammar. 2010. Synthesis and applications of silver nanoparticles. *Arabian Journal of Chemistry*. 3 : 135–140.

Eridia, Matilde., Artur Ciesielski dan Paolo Samorì. 2016. Graphene via Molecule-Assisted Ultrasound-Induced Liquid-Phase Exfoliation: A Supramolecular Approach. *DEGRUYTER*. 20160101.

Feng, H., Cheng, R., Zhao, X., Duan, X., & Li, J. 2013. A low-temperature method to produce highly reduced graphene oxide. *Nature Communications*. 4(1).

Fikri, Achmad Ainul dan W.S. Brams Dwandaru. 2016. Pengaruh Variasi Konsentrasi Surfaktan dan Waktu Ultrasonikasi terhadap Sintesis Material Graphene dengan Metode Liquid Sonication Exfoliation Menggunakan Tweeter Ultrasonication Graphite Oxide Generator. *Jurnal Fisika*. 3 : 5.

Fouras, A., M. J. Kitchen, S. Dubsky, R. A. Lewis, S. B. Hooper dan K. Hourigan. 2009. The past, present, and future of x-ray technology for in vivo imaging of function and form. *Journal of Applied Physics*. 105: 102009

Furi, Trievitas Anna dan Pamilia Coniwanti. 2012. Pengaruh Perbedaan Ukuran Partikel dari Ampas Tebu dan Konsentrasi Natrium Bisulfit ($NaHSO_3$) pada Proses Pembuatan Surfaktan. *Jurnal Teknik Kimia*. 3: 18

Geim, A. K. 2009. Graphene: Status and Prospects. *Science*. 324(5934): 1530–1534.

Geim, A. K. & Novoselov, K. S. 2007. The Rise of Graphene. *Nature Materials*. 6 : 183-191.

Gómez-Navarro, C., Meyer, J. C., Sundaram, R. S., Chuvilin, A., Kurasch, S., Burghard, M., K. Kern., Kaiser, U. 2010. Atomic Structure of Reduced Graphene Oxide. *Nano Letters*. 10(4): 1144–1148.

Grande, L., Chundi, V. T., Wei, D., Bower, C., Andrew, P., & Ryhänen, T. 2012. Graphene for energy harvesting/storage devices and printed electronics. *Particuology*, 10(1): 1–8.

Heyrovska, Raji. 2016. The Coulombic Nature of the van der Waals Bond Connecting Conducting Graphene Layers in Graphite. *Graphene*. 5 : 35-38.

Horikoshi, Satoshi. dan Nick Serpone. 2013. *Introduction to Nanoparticles*. Weinheim : Wiley-VCH Verlag GmbH & Co. KgaA.

Huang, H., Li, Z., She, J., & Wang, W. 2012. Oxygen density dependent band gap of reduced graphene oxide. *Journal of Applied Physics*. 111(5): 054317.

Inkson, B. J. 2016. Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) for materials characterization. *Materials Characterization Using Nondestructive Evaluation (NDE) Methods*. 17 (43).

Ilhami, M. R dan Diah Susanti. 2014. Pengaruh Massa Zn dan Temperatur Hydrotermal Terhadap Struktur dan Sifat Elektrik Material Graphene. *Jurnal Teknik Pomits*. 3: 2

Jayakaran, P., G. S. Nirmala dan L. Govindarajan. 2019. Qualitative and Quantitative Analysis of Graphene-Based Adsorbents in Wastewater Treatment. *International Journal of Chemical Engineering*. ID Artikel : 9872502

Junaidi, M.dan Susanti, D. 2014. Pengaruh Variasi Waktu Ultrasonikasi dan Waktu Tahan Hydrothermal terhadap Struktur dan Konduktivitas Listrik Material Graphene. *Jurnal Teknik Pomits*, 3 : 1-6.

Kazemzadeh, R., Andersen, K., Motha, L., & Kim, W. S. 2015. Highly Sensitive Pressure Sensor Array With Photothermally Reduced Graphene Oxide. *IEEE Electron Device Letters*. 36(2): 180–182.

Khakim, A. 2014. *Pembuatan nanokarbon dari Limbah Baterai untuk Aplikasi Elektroda pada Superkapasitor*. Skripsi. Institut Pertanian Bogor.

Khrapach, I., Withers, F., Bointon, T. H., Polyushkin, D. K., Barnes, W. L., Russo, S., & Craciun, M. F. 2012. Novel Highly Conductive and Transparent Graphene-Based Conductors. *Advanced Materials*. 24(21): 2844–2849.

Khan, Majharul Maque dan A.S.W. Kurny. 2012. Characterization of Spent Household Zinc-Carbon Dry Cell Batteries in the Process of Recovery of Value Metals. J*ournal of Minerals & Materials Characterization & Engineering*. 6 : 641-651

Kristianingrum, Susila. 2014. *Handout Spektroskopi Infra Merah*. Yogyakarta: Jurusan Pendidikan Kimia Universitas Negeri Yogyakarta.

Lai, Qi., Shifu Zhu, Xueping Luo, Min Zou dan Shuanghua Huang. 2012. Ultraviolet-Visible Spectroscopy of Graphene Oxide. *AIP Advances*, 2 : 1-5.

Levinson, Harry J., F. Greuter dan E. W. Plummer. 1983. Experimental band Structure of Aluminium. *Physical Review B*, 27 : 2.

Li, Jianchang., Xiangqiong Zeng, Tianhui Rendan Emile van der Heide. 2014. The Preparation of Graphene Oxide and Its Derivatives and Their Application in Bio-Tribological Systems. *Lubricants*, 2 : 137-161.

Liu, L., & Shen, Z. 2009. Bandgap engineering of graphene: A density functional theory study. *Applied Physics Letters*. 95(25): 252104.

Mahmood, S. H., Ghada H. D., Ibrahim B., Mufeed A., Hassan K. J., Bashar I. L., and Murad A. A. 2014. Magnetic Properties and Hyperfine Interactions in M-Type $BaFe_{12-2x}Mo_xZn_xO_{19}$ Hexaferrites. *Journal of Applied Mathematics and Physics*. 2: 77-87

Mkhoyan, K. A., Contryman, A. W., Silcox, J., Stewart, D. A., Eda, G., Mattevi, C., S. Miller., Chhowalla, M. 2009. Atomic and Electronic Structure of Graphene-Oxide. *Nano Letters*. 9(3): 1058–1063.

Nandiyanto, Asep Bayu Dani, Rosi Oktiani dan Risti Ragadhita. 2019. How to Read and Interpret FTIR Spectroscope of Organic Material. *Indonesian Journal of Science & Technology*. 4 : 1.

Neto, A. H. Castro., Guinea, F., Peres, N. M. R., Novoselov, K. S., & Geim, A. K. 2009. The electronic properties of graphene. *Reviews of Modern Physics*, 81(1): 109–162.

Nourbakhsh, A., Cantoro, M., Vosch, T., Pourtois, G., Clemente, F., van der Veen, M. H., … Sels, B. F. 2010. Bandgap opening in oxygen plasma-treated graphene. *Nanotechnology*. 21(43): 435203.

Novoselov, K. S., Jiang, D., Schedin, F., Booth, T. J., Khotkevich, V. V., Morozov, S. V., & Geim, A. K. 2005. Two-dimensional atomic crystals. *Proceedings of the National Academy of Sciences*, 102(30) : 10451–10453.

Nugraha, Yoga. 2016. Pengenalan Spektroskopi FTIR. Bandung: Prodi Pendidikan Kimia Pascasarjana FMIPA UPI.

Nursetiani, Ika Devia., Kasmui dan Agung Tri Prasetya. 2013. Pengaruh Enkapsulasi Logam Terhadap Nilai Celah Pita Boron Nitride Nanotubes$_{(4,4)}$. *Indonesian Journal of Chemical Science*. 2(1)

Oldenburg, S.J. 2014. Silver Nanoparticles: Properties and Applications. (Online): (www.sigmaaldrich.com/materials-science/nanomaterials/silver-nanoparticles.html. diakses 22 Mei 2020)

Osiak, Michal., Hugh Geaney, Eileen Armstrong dan Colm O'Dwyer. 2014. Structuring materials for lithium-ion batteries: advancements in nanomaterial structure, composition, and defined assembly on cell performance. *Journal of Materials Chemistry A*. 2 : 9433–9460.

Partoens, B., & Peeters, F. M. 2006. From graphene to graphite: Electronic structure around theKpoint. *Physical Review B*. 74(7)

Pattarith, Kongsak dan Yonrapach Areerob. 2020. Fabrication of Ag Nanoparticles Adhered on RGO Based on Both Electrodes in Dye-Sinsitized Solar Cells (DSSCs). *Renewables : Wind, Water, and Solar*. 7(1)

Pei, S., & Cheng, H.-M. 2012. The reduction of graphene oxide. *Carbon*. 50(9): 3210–3228.

Perrozzi, F., S Prezioso dan L Ottaviano. 2015. Graphene oxide: from fundamentals to applications. *Journal of Physics: Condensed Matter*. 013002.

Pinto, H., & Markevich, A. 2014. Electronic and Electrochemical Doping of Graphene by Surface Adsorbates. *Beilstein Journal of Nanotechnology*. 6 : 1842-1848.

Podzorov, V., Menard, E., Borissov, A., Kiryukhin, V., Rogers, J. A., & Gershenson, M. E. 2004. Intrinsic Charge Transport on the Surface of Organic Semiconductors. *Physical Review Letters*. 93(8).

Pumera, M. 2011. Graphene in biosensing. *Materials Today*. 14(7-8): 308–315.

Pumera, M., Ambrosi, A., Bonanni, A., Chng, E. L. K., & Poh, H. L. 2010. Graphene for electrochemical sensing and biosensing. *TrAC Trends in Analytical Chemistry*. 29(9): 954–965.

Raya, Indah., Awais Ahmad., Ayad F. Alkaim., Dmitry Bokov., Enas R. Alwaily., Rafael Luque., Mabkhoot Alsaiari dan Mohammed Jalalah. 2021. Synthesis, Characterization and Photodegradation Studies of Copper Oxide-Graphene Nanocomposites. *Coatings*. 11: 1452.

Ristian, Ina. 2013. *Kajian Pengaruh Konsentrasi Perak Nitrat (AgNO3) Terhadap Ukuran Nanopartikel Perak*. Skripsi. FMIPA Universitas Negeri Semarang.

Schramm, Laurier L., Elaine N. Stasiuk dan D. Gerrard Marangoni. Surfactants and their applications. *Annu. Rep. Prog. Chem., Sect. C*. 99 : 3-48.

Setiadji, S., Nuryadin, B. W., Ramadhan, H., Sundari, C. D. D., Sudiarti, T., Supriadin, A., and Ivansyah, A. L. 2018. Preparation of reduced Graphene Oxide (rGO) assisted by microwave irradiation and hydrothermal for reduction methods. *IOP Conference Series: Materials Science and Engineering*. 434(1).

Simpson, P D., C J Martin, C L Darragh dan R Abel. 1998. A study of chest radiography with mobile X-ray units. *The British Journal of Radiology*. 71 : 640-645.

Smallman, R. E. and R. J. Bishop. 1999. *Modern Physical Metallurgy and Materials Engineering*. Jilid VI. Butterworth-Heinemann: Oxford.

Scrosati, Bruno dan Jürgen Garche. 2010. Lithium batteries: Status, prospects and future. *Journal of Power Sources*. 195: 2419–2430.

Shalaby, A., D. Nihtianova., P. Markov., A. D. Staneva., R. S. Iordanova., Y. B. Dimitriev. 2015. Structural Analysis of Reduced Graphene Oxide by Transmission Electron Microscopy. *Bulgarian Chemical Communications*. 47 (1)

Shao, W., Liu, X., Min, H., Dong, G., Feng, Q., & Zuo, S. 2015. Preparation, Characterization, and Antibacterial Activity of Silver Nanoparticle-Decorated Graphene Oxide Nanocomposite. *ACS Applied Materials & Interfaces*. 7(12): 6966–6973.

Shao, Y., Wang, J., Wu, H., Liu, J., Aksay, I. A., & Lin, Y. 2010. Graphene Based Electrochemical Sensors and Biosensors: A Review. *Electroanalysis*. 22(10): 1027–1036.

Shen, J., Min Shi., Na Li., Bo Yan., Hongwei Ma., Yizhe Hu and Mingxin Ye. 2010. Facile Synthesis and Application of Ag-Chemically Converted Graphene Nanocomposite. *Nano Res*. 3: 339-349.

Siburian, R., H. Sihotang., S. Lumban Raja., M. Supeno dan C. Simanjuntak. 2018. New Route to Synthesize of Graphene Nano Sheets. *Oriental Journal of Chemistry*. 34 (1)

Thebo, K. H., Qian, X., Zhang, Q., Chen, L., Cheng, H.-M., & Ren, W. 2018. Highly stable graphene-oxide-based membranes with superior permeability. *Nature Communications*. 9(1).

Tokyo Chemical Industry. 2010. Graphenes, Graphene Oxides (GOs), (Online), (https://www.tcichemicals.com/KR/ko/c/12962#, diakses 20 Mei 2020)

Trivedi, Shivam., Lobo, K., & Ramakrishna Matte, H. S. S. 2019. Synthesis, Properties, and Applications of Graphene. *Fundamentals and Sensing Applications of 2D Materials*, 25(90).

Wang, L., Wang, H.-Y., Wang, Y., Zhu, S.-J., Zhang, Y.-L., Zhang, J.-H., … Sun, H.-B. 2013. Direct Observation of Quantum-Confined Graphene-Like States and Novel Hybrid States in Graphene Oxide by Transient Spectroscopy. *Advanced Materials*. 25(45): 6539–6545.

Wang, P. dan Hu, A. 2014. Carbon Quantum Dots: Synthesis, Properties and Applications. *The Royal Society of Chemistry*. 2: 6921-6939.

Wang, X., Zhi, L., & Müllen, K. 2008. Transparent, Conductive Graphene Electrodes for Dye-Sensitized Solar Cells. *Nano Letters*. 8(1): 323–327.

Wang, Y., Chen, Y., Lacey, S. D., Xu, L., Xie, H., Li, T., V. A. Danner and Hu, L. 2018. Reduced graphene oxide film with record-high conductivity and mobility. *Materials Today*. 21(2): 186–192.

Wang, Y., L. Wang., H.-Y. Wang., Q.-D. Chen and H.-B. Sun. 2019. Ultrafast Spectroscopic Study of Insulator−Semiconductor Semimetal Transitions in Graphene Oxide and Its Reduced Derivatives. *J. Phys. Chem. C*. 123: 22550–22555.

Widiyawati, N. 2012. *Analisis Pengaruh Heating Heat Terhadap Tingkat Kristal dan Ukuran Butir Lapisan Tipis BZT yang Ditumbuhkan Dengan Metode Sol Gel*. Skripsi tidak diterbitkan. Surakarta: FMIPA Universitas Sebelas Maret.

Xu, Yanyan., Huizhe Cao, Yankin Xue, Biao Li dan Weihua Cai. 2018. Liquid-Phase Exfoliation of Graphene: An Overview on Exfoliation Media, Techniques, and Challenges. *Nanomaterials*. 8 : 942.

Yeh, C.-N., Raidongia, K., Shao, J., Yang, Q.-H., & Huang, J. 2015. On the origin of the stability of graphene oxide membranes in water. *Nature Chemistry*. 7(2): 166–170.

Zhang, F., Zhang, T., Yang, X., Zhang, L., Leng, K., Huang, Y., & Chen, Y. 2013. A high-performance supercapacitor-battery hybrid energy storage device based on graphene-enhanced electrode materials with ultrahigh energy density. *Energy & Environmental Science*. 6(5): 1623.

Zhang, Y., Tang, T.-T., Girit, C., Hao, Z., Martin, M. C., Zettl, A. Wang, F. 2009. Direct observation of a widely tunable bandgap in bilayer graphene. *Nature*. 459(7248): 820–823.

Zulianingsih, Nika. 2012. *Analisa Pengaruh Jumlah Lapisan Tipis BZT yang Ditumbuhkan dengan Metode Sol Gel Terhadap Ketebalan dan Sifat Listrik*. Skripsi tidak diterbitkan. Surakarta: FMIPA Universitas Sebelas Maret.

LAMPIRAN

BAGAN KERJA

1. Preparasi Bahan

Limbah Baterai

- Dibuka menggunakan palu dan tang.
- Diambil batang baterainya.

Batang Baterai

- Dihaluskan menggunakan palu.

Serbuk Karbon

- Dianalisis dengan FTIR XRD dan SEM

Data FTIR, XRD dan SEM Serbuk Karbon

2. Sintesis *Graphene Oxide* dengan Metode LE dan Radiasi Sinar-X menggunakan surfaktan.

Serbuk Karbon

- Ditimbang sebanyak 0,6 gram
- Ditambahkan aquabides 100 mL
- Ditambahkan Linear Alkylbenzene Sulfonate (LABS) sebanyak 0,6 gram

Campuran

- Dituangkan ke dalam beker gelas
- Diambil masing-masing 15 mL dan dimasukan ke dalam 4 buah gelas kimia.
- Gelas kimia 1 di uji dengan UV-Vis sebagai 0 menit. Gelas kimia 1, 2 dan 3 diaduk selama 3 jam dengan magnetic stirrer.
- Tiap satu jam dilakukan pengujian dengan UV-Vis

Data UV-Vis Sampel 1 (0 jam, 1 jam, 2 jam, 3 jam

3. Sintesis *Graphene Oxide* dengan Metode LE dan Radiasi Sinar-X tanpa surfaktan.

Serbuk Karbon

- Ditimbang sebanyak 0,6 gram
- Ditambahkan aquabides 100 mL

Campuran

- Dituangkan ke dalam beker gelas
- Diambil masing-masing 15 mL dan dimasukan ke dalam 4 buah gelas kimia.
- Gelas kimia 1 di uji dengan UV-Vis sebagai 0 menit. Gelas kimia 1, 2 dan 3 diaduk selama 3 jam dengan magnetic stirrer
- Tiap satu jam dilakukan dengan UV-Vis

Data UV-Vis sampel 2 (0 jam, 1 jam, 2 jam dan 3 jam)

4. Preparasi Sampel

a) Sampel 1 (menggunakan surfaktan)

Sampel 1

- Dibuat wadah berbentuk bulat sebanyak 4 buah dan dilapisi Aluminium foil.
- Semua sampel 1 dituangkan ke dalam wadah masing-masing 5 mL.
- Ke dalam sampel dimasukan kaca preparat dan dioven dengan suhu 150 ^{o}C selama 60 menit.

Graphene Oxide

(dengan surfaktan)

b) Sampel 2 (tanpa Surfaktan)

Sampel 2

- Dibuat wadah berbentuk bulat sebanyak 4 buah dan dilapisi Aluminium foil.
- Semua sampel bagian 2 dituangkan ke dalam wadah masing-masing 5 mL.
- Ke dalam sampel dimasukan kaca preparat dan dioven dengan suhu 150 ^{o}C selama 60 menit.

Graphene Oxide

(tanpa surfaktan)

5. Karakterisasi *Graphene Oxide*

a) Analisis dengan SEM

Graphene Oxide

(dengan surfaktan)

Sampel GO (dengan surfaktan) dianalisis dengan SEM

Data SEM Graphene Oxide (dengan Surfaktan)

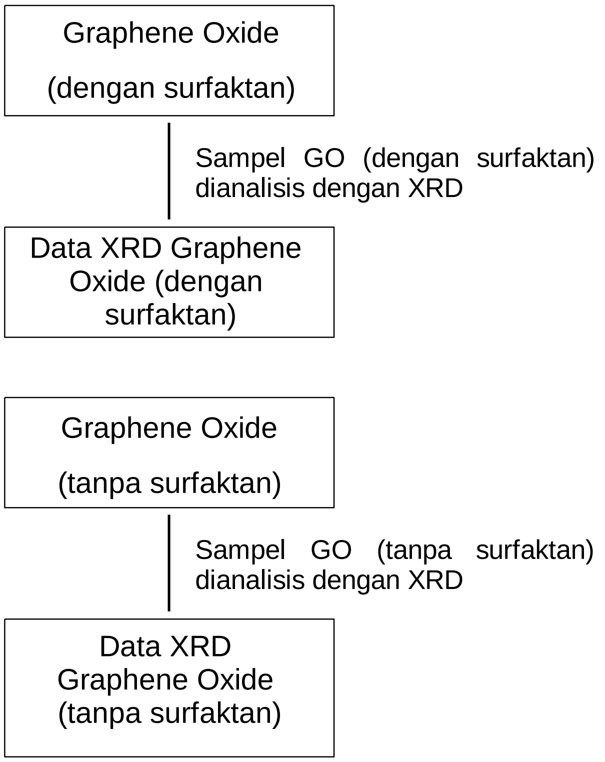
Graphene Oxide

(tanpa surfaktan)

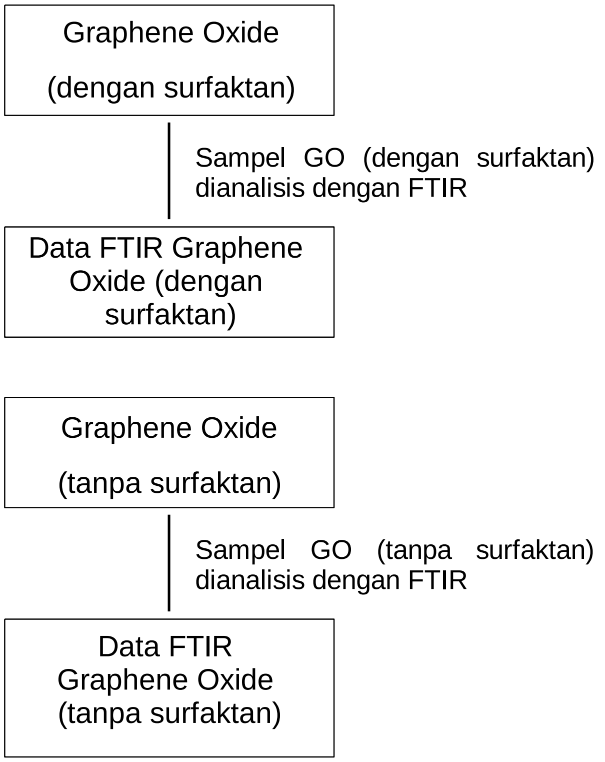
Sampel GO (tanpa surfaktan) dianalisis dengan SEM

Data SEM Graphene Oxide (tanpa surfaktan)

b) Analisis dengan XRD



c) Analisis dengan FTIR



d) Uji Sifat Superkonduktor

Graphene oxide

- Graphene Oxide di uji menggunakan UV DRS.

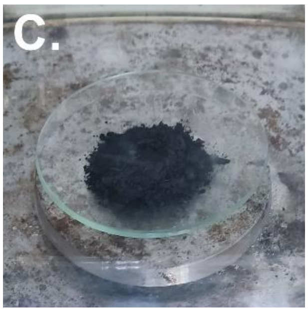
Pengujian dilakukan untuk menentukan energi celah pita sebagai salah satu sifat superkonduktor

Data UV DRS, Graphene Oxide

A. LAMPIRAN DOKUMENTASI

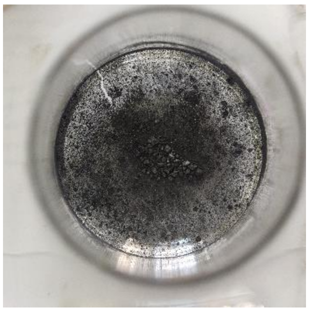
Sampel Limbah Baterai

Batang Karbon Baterai



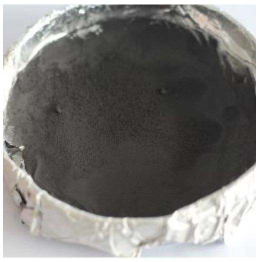
Serbuk Karbon

Penembakan Sinar-X

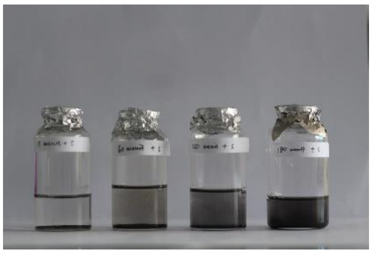


Sintesis Tanpa Surfaktan

Sintesis dengan Surfaktan



Hasil Oven



Sintesis GO dengan Surfaktan

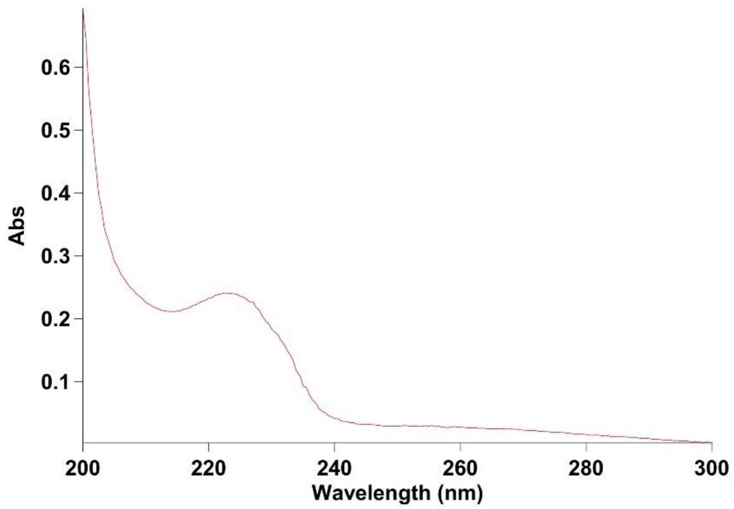
Sintesis GO tanpa surfaktan

B. LAMPIRAN HASIL UV-VIS

UV-VIS dilakukan di Jurusan Kimia Universitas Islam Negeri Alauddin Makassar.

1. Sintesis GO tanpa bantuan surfaktan (0, 1, 2 dan 3 Jam)

3/10/2021 2:08:10 PM Page 1 of 1



Scan Analysis Report

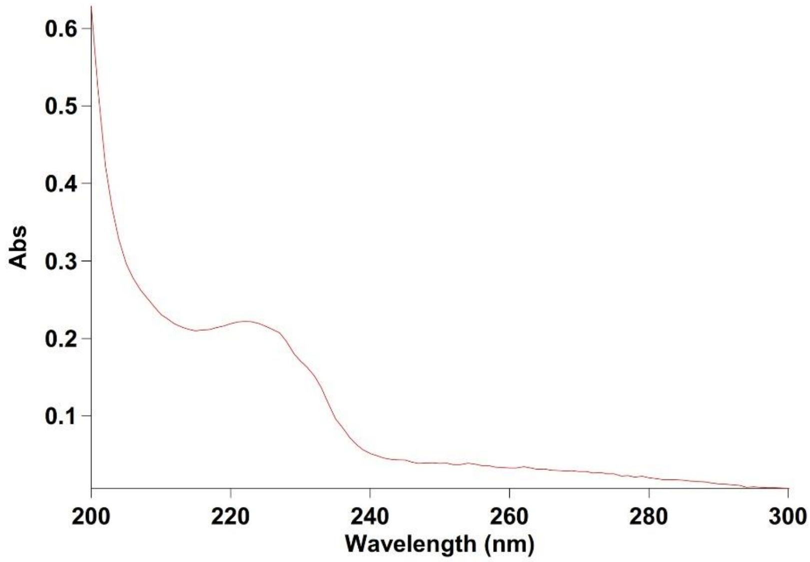
Report Time : Wed 10 Mar 02:08:04 PM 2021
Method:
Batch:
Software version: 3.00(339)
Operator:

Sample Name: GOS 0 menit

Collection Time	3/9/2021 11:45:20 AM
Peak Table	
Peak Style	Peaks
Peak Threshold	0.0100
Range	300.1nm to 200.0nm

Wavelength (nm)	Abs
222.9	0.241

3/10/2021 2:11:35 PM Page 1 of 1



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Batch:
Software version: 3.00(339)
Operator:

Sample Name: GOS 1 jam

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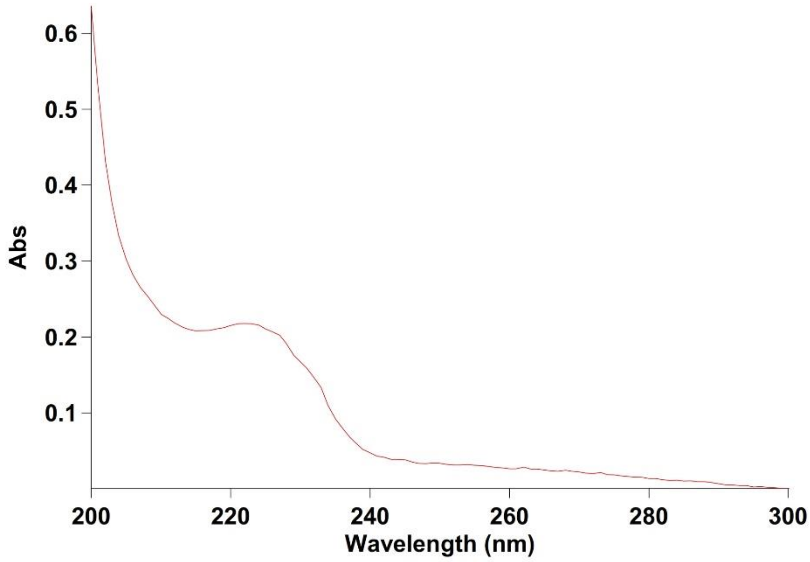
Peak Table	
Peak Style	Peaks
Peak Threshold	0.0100
Range	300.1nm to 200.0nm

Wavelength (nm)	Abs
222.0	0.222

3/10/2021 2:14:35 PM Page 1 of 1



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Operator:

Sample Name: GOS 2 jam

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Peak Style	Peaks
Peak Threshold	0.0100
Range	300.1nm to 200.0nm

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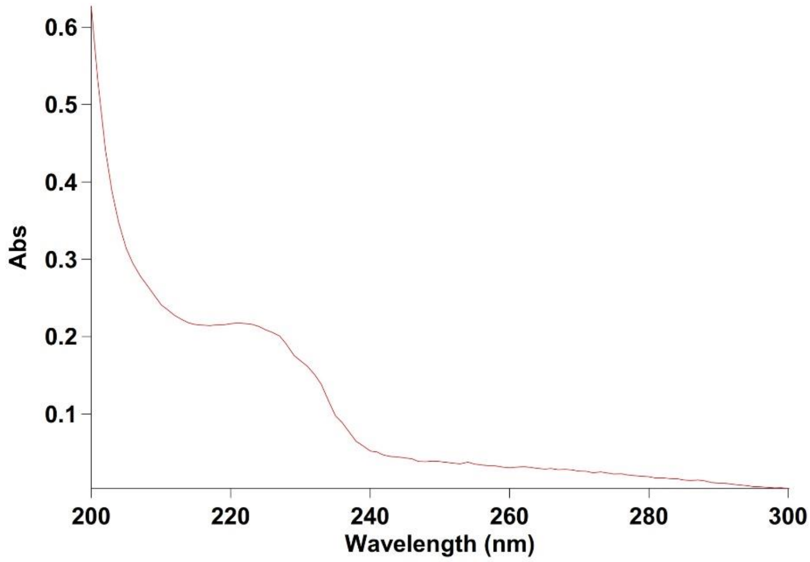
3/10/2021 2:17:25 PM   Page 1 of 1



Scan Analysis Report

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Batch:
Software version: 3.00(339)
Operator:

Sample Name: GOS 3 jam

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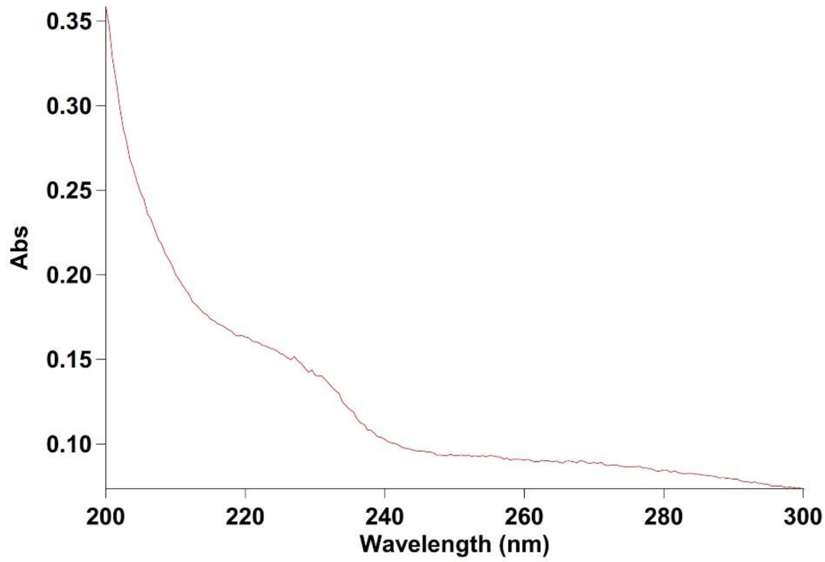
Peak Table	
Peak Style	Peaks
Peak Threshold	0.0100
Range	300.1nm to 200.0nm

No peak found above threshold

2. Sintesis GO dengan bantuan surfaktan (0, 1, 2 dan 3 Jam)

3/10/2021 2:05:35 PM Page 1 of 1



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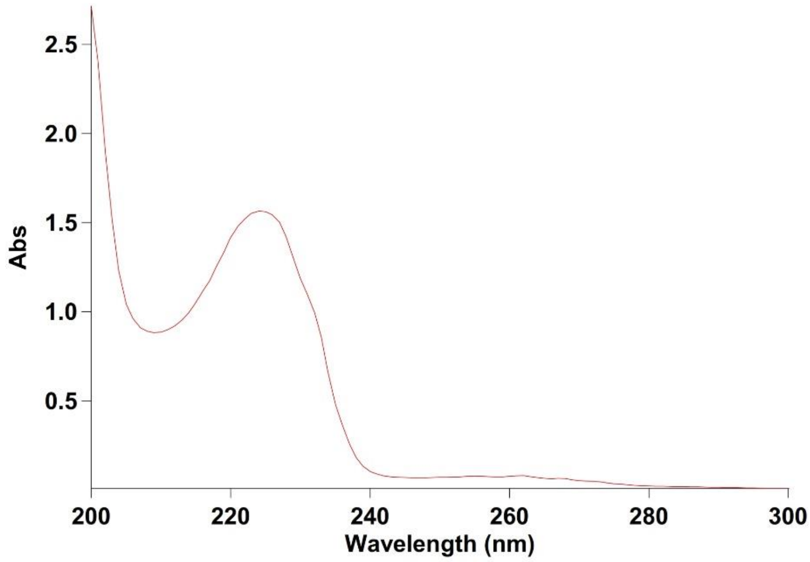
Method:
Batch:
Software version: 3.00(339)
Operator:

<u>Sample Name: GO 0 menit</u>

Collection Time	3/9/2021 11:37:23 AM

Peak Table	
Peak Style	Peaks
Peak Threshold	0.0100
Range	300.1nm to 200.0nm

No peak found above threshold



Scan Analysis Report

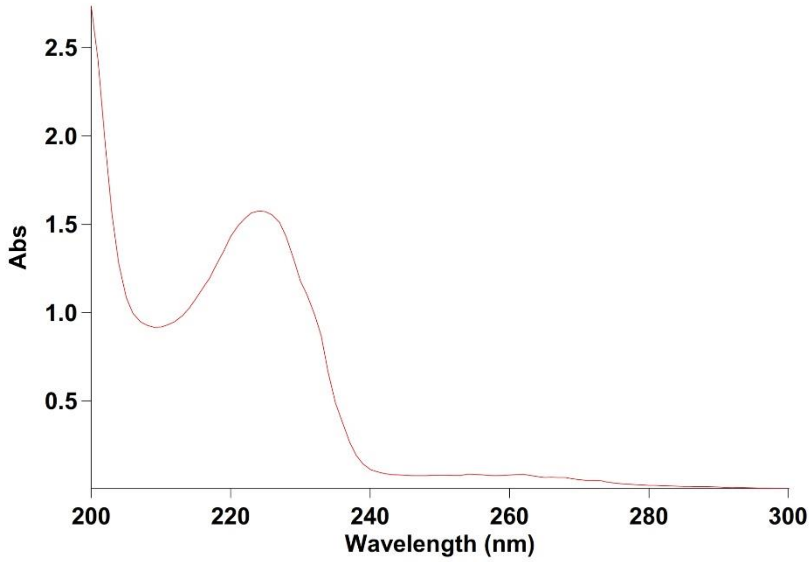
Report Time : Wed 10 Mar 02:10:06 PM 2021
Method:
Batch:
Software version: 3.00(339)
Operator:

Sample Name: GO 1 jam

Collection Time	3/9/2021 12:47:58 PM
Peak Table	
Peak Style	Peaks
Peak Threshold	0.0100
Range	300.1nm to 200.0nm

Wavelength (nm)	Abs
262.1	0.079
224.0	1.564

3/10/2021 2:13:34 PM Page 1 of 1



Scan Analysis Report

Report Time : Wed 10 Mar 02:13:28 PM 2021
Method:
Batch:
Software version: 3.00(339)
Operator:

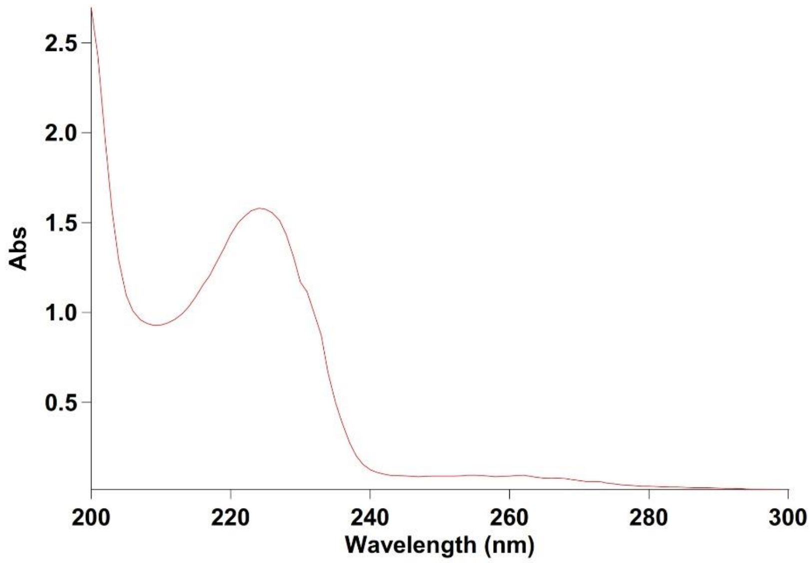
Sample Name: GO 2 jam

Collection Time 3/9/2021 1:55:40 PM

Peak Table	
Peak Style	Peaks
Peak Threshold	0.0100
Range	300.1nm to 200.0nm

Wavelength (nm)	Abs
224.0	1.576

3/10/2021 2:15:40 PM Page 1 of 1



Scan Analysis Report

Report Time : Wed 10 Mar 02:15:36 PM 2021
Method:
Batch:
Software version: 3.00(339)
Operator:

Sample Name: GO 3 jam

Collection Time 3/9/2021 3:05:11 PM

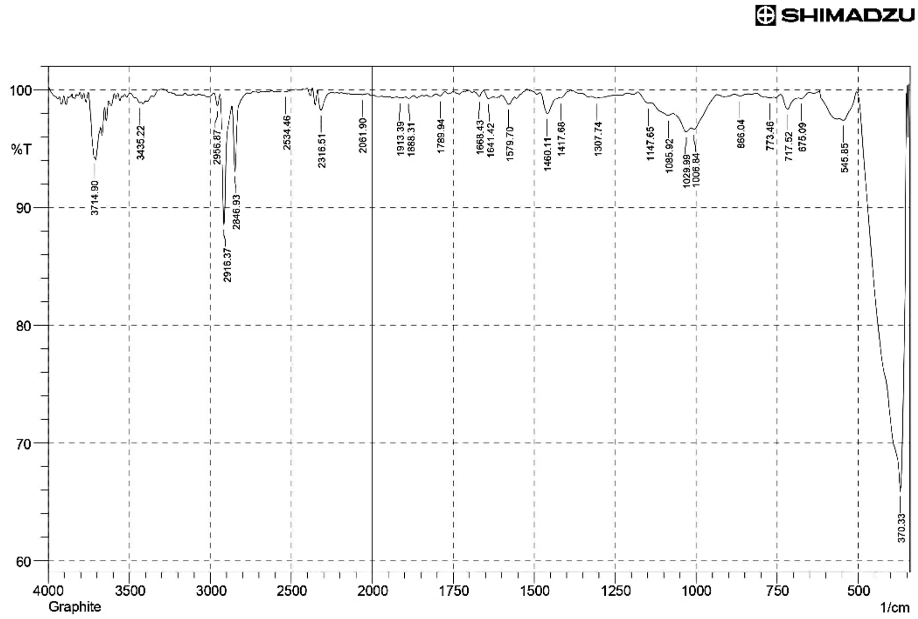
Peak Table	
Peak Style	Peaks
Peak Threshold	0.0100
Range	300.1nm to 200.0nm

Wavelength (nm)	Abs
224.0	1.579

C. LAMPIRAN HASIL FTIR

FTIR dilakukan di laboratorium Terpadu FMIPA UNHAS

1. Sampel Graphite Limbah Baterai

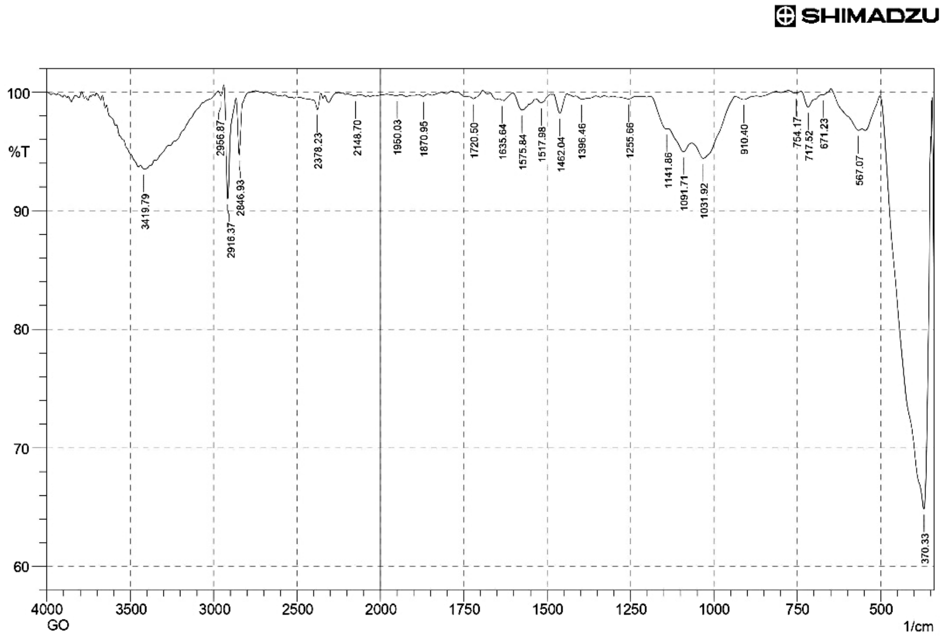


No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	370.33	65.9329	33.7043	503.42	351.04	14.6155	14.4246
2	545.85	97.4166	0.7159	559.36	505.35	0.4382	0.1297
3	675.09	99.2641	0.1767	684.73	651.94	0.0787	0.013
4	717.52	98.3579	1.1267	740.67	684.73	0.2458	0.1136
5	773.46	99.3165	0.0882	786.96	759.95	0.0757	0.0057
6	866.04	99.4857	0.1577	881.47	839.03	0.0785	0.0134
7	1006.84	96.6575	0.4373	1016.49	933.55	0.7063	0.0406
8	1029.99	96.432	0.6292	1072.42	1016.49	0.698	0.0519
9	1085.92	97.8287	0.344	1139.93	1072.42	0.5268	0.0684
10	1147.65	98.8748	0.2132	1180.44	1139.93	0.1349	0.0244
11	1307.74	99.2892	0.1768	1323.17	1238.3	0.2091	0.0258
12	1417.68	99.2939	0.1054	1421.54	1386.82	0.0553	0.0029
13	1460.11	97.9908	1.5506	1483.26	1431.18	0.2744	0.1637
14	1579.7	98.7715	0.6887	1600.92	1560.41	0.154	0.0594
15	1641.42	99.2321	0.2567	1654.92	1635.64	0.0451	0.0126
16	1668.43	99.4385	0.4532	1685.79	1654.92	0.0404	0.0252
17	1789.94	99.4758	0.2784	1803.44	1774.51	0.0465	0.0164
18	1888.31	99.2748	0.1608	1897.95	1870.95	0.074	0.0098
19	1913.39	99.2991	0.0898	1924.96	1897.95	0.0773	0.0054
20	2061.9	99.594	0.0528	2090.84	2042.62	0.0798	0.0054
21	2316.51	98.2904	1.6638	2337.72	2260.57	0.3027	0.2669
22	2534.46	99.8529	0.0813	2553.75	2497.82	0.0235	0.0118
23	2846.93	93.103	5.765	2868.15	2769.78	0.8766	0.5257
24	2916.37	88.5836	10.7179	2939.52	2868.15	1.5531	1.2766
25	2956.87	98.6499	1.0226	2976.16	2939.52	0.1322	0.0804
26	3435.22	98.9116	0.1107	3464.15	3427.51	0.1439	0.0058
27	3714.9	94.2216	0.2704	3753.48	3712.97	0.5907	0.0487

Comment;
Graphite

Date/Time; 6/24/2021 10:33:41 AM
No. of Scans;
Resolution;
Apodization;

2. Sampel GO tanpa menggunakan surfaktan



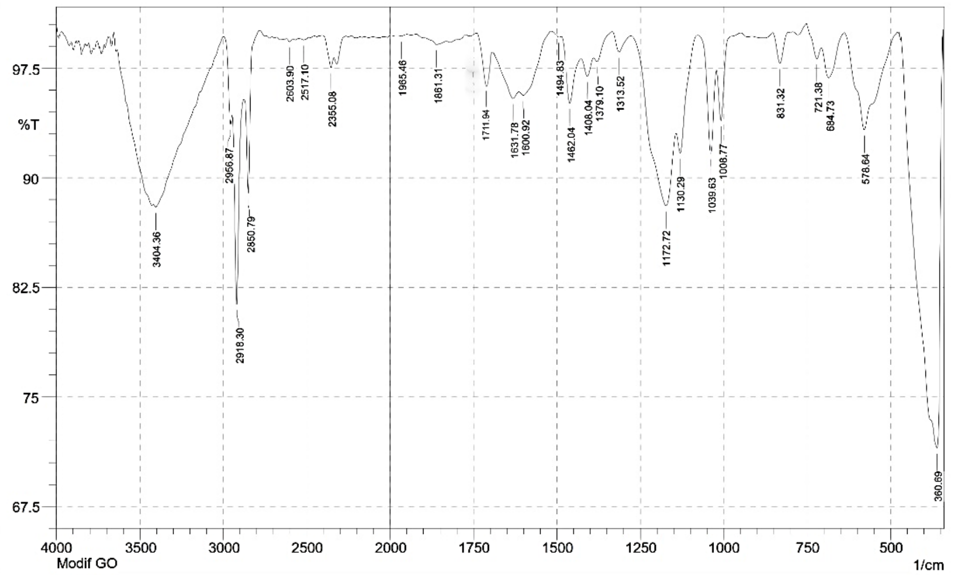
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	370.33	64.8424	28.7831	501.49	352.97	15.8055	13.2692
2	567.07	96.7846	0.5376	648.08	555.5	0.7655	0.1881
3	671.23	99.7716	0.1135	677.01	648.08	0.0062	0.0102
4	717.52	98.7215	1.2406	740.67	677.01	0.1679	0.1471
5	754.17	99.898	0.1874	777.31	740.67	0.0012	0.0161
6	910.4	99.366	0.2794	935.48	873.75	0.128	0.0343
7	1031.92	94.4053	2.3494	1066.64	937.4	2.0873	0.7647
8	1091.71	94.9592	1.1521	1136.07	1068.56	1.2836	0.1729
9	1141.86	96.8882	0.3113	1190.08	1136.07	0.4568	0.0468
10	1255.66	99.424	0.1949	1284.59	1234.44	0.1057	0.0216
11	1396.46	99.3831	0.1767	1415.75	1381.03	0.0765	0.0117
12	1462.04	98.2335	1.6031	1481.33	1440.83	0.1676	0.1389
13	1517.98	99.1092	0.4251	1531.48	1487.12	0.1138	0.0398
14	1575.84	98.4872	1.2162	1602.85	1537.27	0.2831	0.1848
15	1635.64	99.3027	0.0325	1645.28	1633.71	0.0314	0.0002
16	1720.5	99.4224	0.3414	1732.08	1693.5	0.0566	0.0355
17	1870.95	99.6381	0.1802	1886.38	1859.38	0.0316	0.0102
18	1950.03	99.7096	0.0868	1980.89	1938.46	0.0451	0.0087
19	2148.7	99.7007	0.0273	2154.49	2129.41	0.0284	0.0017
20	2378.23	98.5453	1.2151	2430.31	2357.01	0.2497	0.1415
21	2846.93	94.6834	4.9166	2866.22	2789.07	0.5579	0.4663
22	2916.37	91.0129	9.1883	2937.59	2868.15	1.1141	1.104
23	2956.87	99.6833	0.6473	2972.31	2939.52	0.0003	0.0493
24	3232.7	93.4995	0.4392	3439.08	3354.21	2.3772	0.1219

Comment;
GO

Date/Time; 6/24/2021 10:43:50 AM
No. of Scans;
Resolution;
Apodization;

3. Sampel GO menggunakan Surfaktan

SHIMADZU



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	360.69	71.5101	28.5757	468.7	343.33	10.5362	10.4782
2	578.64	93.281	6.6602	638.44	480.28	2.2421	2.2049
3	684.73	96.8425	2.4142	707.88	640.37	0.5357	0.364
4	721.38	98.1465	1.2693	752.24	707.88	0.1735	0.1233
5	831.32	97.8293	2.1179	852.54	806.25	0.2079	0.1976
6	1008.77	93.9161	4.1971	1022.27	979.84	0.5576	0.2841
7	1039.63	91.666	6.4242	1080.14	1022.27	0.8774	0.5125
8	1130.29	91.6968	2.5717	1141.86	1080.14	1.1275	0.2011
9	1172.72	88.0825	6.4013	1278.81	1143.79	4.2553	2.0628
10	1313.52	98.6054	1.2912	1334.74	1278.81	0.1751	0.1415
11	1379.1	97.9587	0.6187	1390.68	1334.74	0.2456	0.0262
12	1408.04	96.9337	1.2428	1427.32	1390.68	0.3913	0.0982
13	1462.04	95.0924	3.9373	1487.12	1427.32	0.7244	0.4382
14	1494.83	99.6226	0.1382	1517.98	1487.12	0.0261	0.0063
15	1600.92	95.6405	0.74	1612.49	1517.98	1.0281	0.2096
16	1631.78	95.4347	1.0165	1735.93	1614.42	1.2599	0.1591
17	1759.08	99.697	0.0466	1762.94	1741.72	0.02	0.0017
18	1861.31	99.1286	0.325	1897.95	1832.38	0.193	0.0409
19	1711.94	99.6968	0.0854	1978.97	1950.03	0.032	0.005
20	2355.08	97.5331	1.0698	2407.16	2337.72	0.409	0.1004
21	2517.1	99.4278	0.1542	2549.89	2486.24	0.1365	0.0205
22	2603.9	99.3218	0.1898	2621.26	2580.76	0.1029	0.0165
23	2850.79	88.9234	7.7674	2877.79	2781.35	1.512	0.5374
24	2918.3	81.3446	13.3596	2945.3	2879.72	3.1881	1.6723
25	2956.87	93.6584	1.5924	3001.24	2947.23	0.6917	-0.0372
26	3404.36	87.9808	0.6079	3419.79	3001.24	12.0073	0.3506

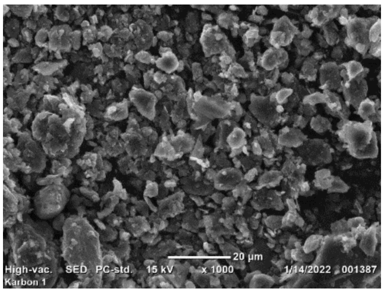
Comment;
Modif GO

Date/Time; 9/3/2021 3:12:57 PM
No. of Scans;
Resolution;
Apodization;

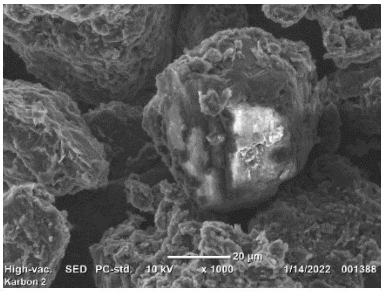
D. LAMPIRAN HASIL SEM

SEM dilakukan di lab Fakultas Teknik Kimia UMI

1. Perbesaran 1.000 x

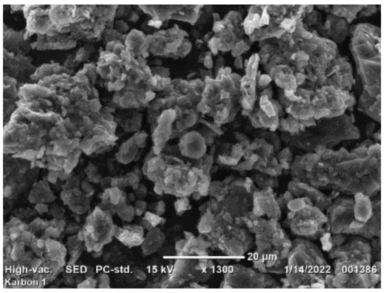


Sampel Graphite

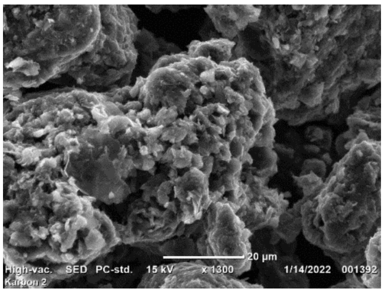


Sampel Graphene Oxide

2. Perbesaran 1.300x

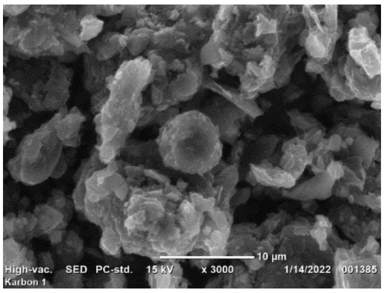


Sampel Graphite

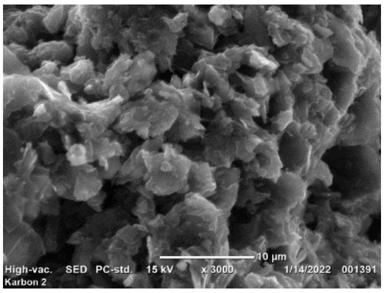


Sampel Graphene Oxide

3. Perbesaran 3.000x

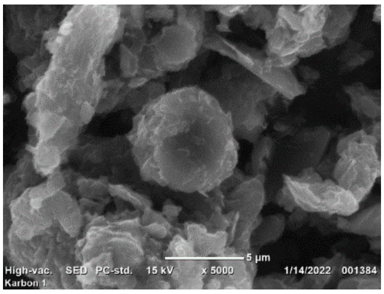


Sampel Graphite

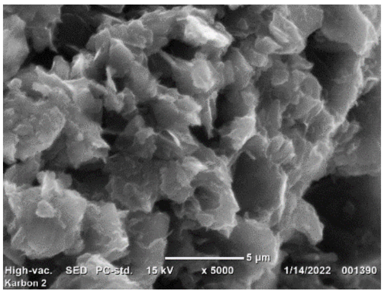


Sampel Graphene Oxide

4. **Perbesaran 5.000x**

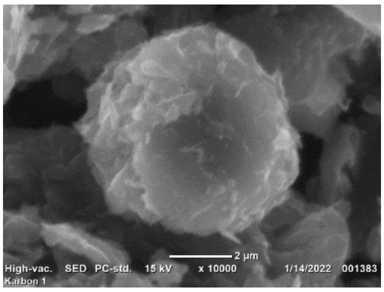


Sampel Graphite

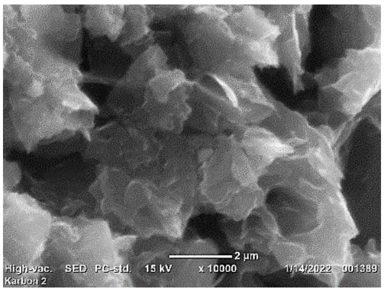


Sampel Graphene Oxide

5. **Perbesaran 10.000x**



Sampel Graphite



Sampel Graphene Oxide

E. LAMPIRAN UV DRS

UV DRS dilakukan di Jurusan Kimia FMIPA Universitas Indonesia

LABORATORIUM UJI KIMIA
DEPARTEMEN KIMIA-UKK LST,
FMIPAUNIVERSITAS INDONESIA
LAB UI - CHEM KIMIA UI

Gedung G Departemen Kimia, Gedung Multidisiplin lt.7
Fakultas Matematika dan Ilmu Pengetahuan Alam
Kampus UI Depok 16424
Tlp. : +6221 78849006
Email : uichemlab@gmail.com

LABORATORY TEST RESULTS

Customer : **Irma Nurfitasari**
Date Completed: October 26th 2021
Date Received : October 07th 2021

Parameter : %R, Abs
Test Number : 126-SPK-021
Sample Matrix : Serbuk Oksida

No.	Sample Name	Sample Code	Parameter	Method
1	ZnO	071021-0673	%R, Abs	Spektrofotometer Uv-DRS
2	Ag/TiO2	071021-0674	%R, Abs	Spektrofotometer Uv-DRS
3	TiO2	071021-0675	%R, Abs	Spektrofotometer Uv-DRS
4	Cu/ZnO	071021-0676	%R, Abs	Spektrofotometer Uv-DRS
5	Co/ZnO	071021-0677	%R, Abs	Spektrofotometer Uv-DRS
6	TiO2/ZnO	071021-0678	%R, Abs	Spektrofotometer Uv-DRS
7	Graphite Oxide	071021-0679	%R, Abs	Spektrofotometer Uv-DRS

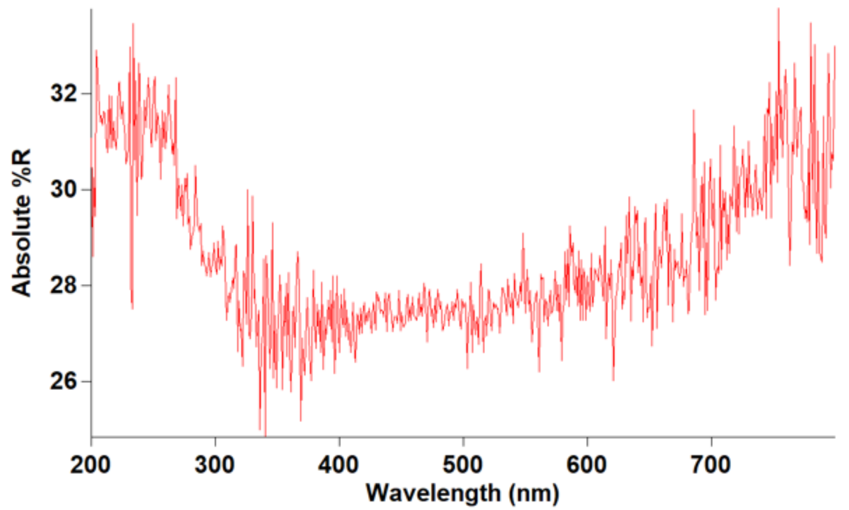
Catatan:
1.Hasil yang ditampilkan hanya berhubungan dengan sampel yang diuji
2.Laporan Pengujian tidak boleh digandakan tanpa persetujuan tertulis dari laboratorium

Depok, October 26th 2021

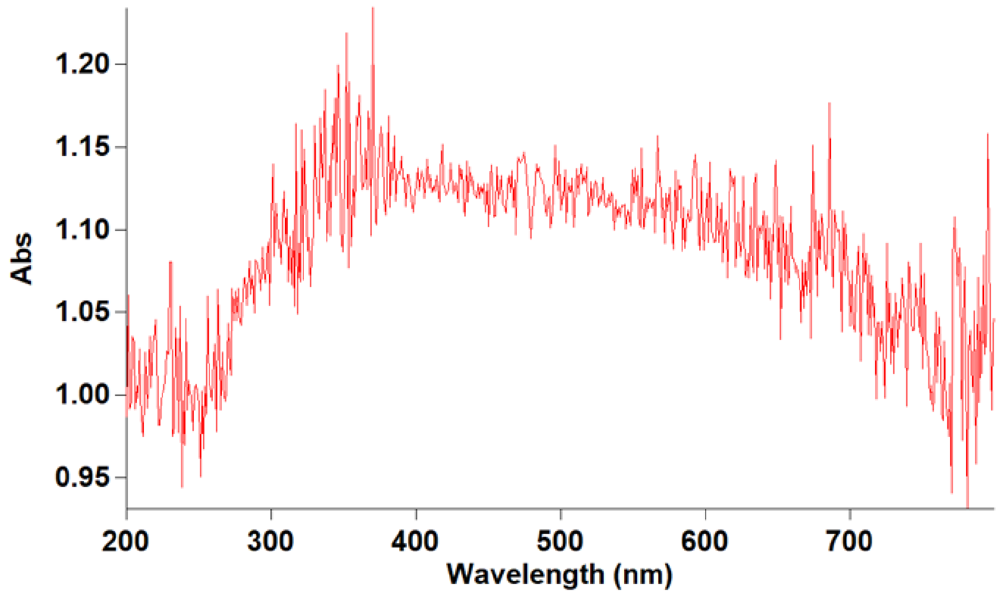
Hedi Surahman
Lab UI-CHEM Departemen Kimia
FMIPA Universitas Indonesia

	0679(%R)FIX	
2	Wavelength (nm)	Absolute %R
3	199.9851532	31.08812904
4	201.0157166	28.6020298
5	202.0065765	30.25333023
6	202.9973602	29.45393753
7	203.9880524	32.90970993
8	205.0183258	32.41677094
9	206.0088654	31.98919868
10	206.9993591	31.4075222
11	207.9897461	31.53943253
12	209.0196686	31.33930016
13	210.009903	31.63173676
14	211.0000763	31.59096909
15	211.9901428	31.14391899
16	213.0197449	30.7738781
17	214.0096588	31.971632
18	214.9994812	30.87632942
19	215.9892578	31.9493084
20	217.0184937	30.8702755
21	218.0081024	31.42778206
22	218.9975739	31.05127716
23	219.9869995	30.84331703
24	221.0159149	31.29189491

0679(%R)FIX



	0679(Abs)FIX	
2	Wavelength (nm)	Abs
3	199.9851532	0.98623
4	201.0157166	1.060282
5	202.0065765	0.991307
6	202.9973602	0.995745
7	203.9880524	1.035139
8	205.0183258	1.031783
9	206.0088654	0.991315
10	206.9993591	1.005226
11	207.9897461	0.998219
12	209.0196686	1.027927
13	210.009903	0.998504
14	211.0000763	0.978723
15	211.9901428	0.974948
16	213.0197449	1.025773
17	214.0096588	0.991939
18	214.9994812	1.003648
19	215.9892578	1.035651
20	217.0184937	1.004792
21	218.0081024	1.031895
22	218.9975739	1.033175
23	219.9869995	1.045899
24	221.0159149	1.021511



0679(Abs)FIX

F. LAMPIRAN ANALISIS DATA

1. Perhitungan nilai *d-spacing*

Perhitungan nilai *d-spacing* menggunakan persamaan Bragg's

$$\boldsymbol{n\,\lambda = 2\,d\,sin\theta}$$

atau

$$\boldsymbol{d = \frac{n\,\lambda}{2\,sin\theta}} \quad (1)$$

Ket :

λ = 1.5406 Å

θ = Posisi puncak (dalam Radian)

n = 1 (prde fraksi)

d = interplanar spasi atau *d-spacing* (Å)

a. Jarak antar lapisan (*d-spacing*) pada sampel graphite

2θ = 21,41º

$\theta = \frac{21.41}{2} = 10{,}7052$

$d = \frac{1 \times 1{,}5406}{2\sin(0{,}186842)}$

$d = 4{,}1468$ Å

2θ = 25,15º

$\theta = \frac{25.15}{2} = 12{,}5779$

$d = \frac{1 \times 1{,}5406}{2\sin(0{,}219525)}$

$d = 3{,}5372$ Å

2θ = 26,46º

$\theta = \frac{26.46}{2} = 13{,}2307$

$d = \frac{1 \times 1{,}5406}{2\sin(0{,}230919)}$

$d = 3{,}3656$ Å

b. Jarak antar lapisan (*d-spacing*) pada sampel tanpa surfaktan

2θ = 18,73°

$\theta = \frac{18,73}{2} = 9,3663$

$d = \frac{1 \times 1,5406}{2\sin(0,163472)}$

$d = 4,7331\ Å$

2θ = 22,02°

$\theta = \frac{22,02}{2} = 11,0143$

$d = \frac{1 \times 1,5406}{2\sin(0,192235)}$

$d = 4,0318\ Å$

c. Jarak antar lapisan (*d-spacing*) pada sampel dengan surfaktan

2θ = 7,3°

$\theta = \frac{7,3}{2} = 3,6692$

$d = \frac{1 \times 1,5406}{2\sin(0,06403)}$

$d = 12,0365\ Å$

2θ = 10,66°

$\theta = \frac{10,66}{2} = 5,3348$

$d = \frac{1 \times 1,5406}{2\sin(0,09310)}$

$d = 8,2848\ Å$

2. Perhitungan nilai celah pita atau *band gap*

Perhitungan nilai celah pita menggunakan Tauc Plot

$$(\alpha hv)^{\gamma} = A(hv - Eg) \quad (1)$$

$$E = hv \quad (2)$$

maka $E = \frac{h.c}{\lambda}$

Jadi, $hv = E = \frac{h.c}{\lambda} = \frac{1240}{\lambda} eV$

$$\alpha = 2{,}302x\ A\ cm^{-1} \quad (3)$$

Ket :

λ = Panjang gelombang

h = konstanta Planck = 6,34x10^{-34} Js

c = 2,998 x 10^{8} m/s

n = frekuensi vibrasi

α = koefisien absorpsi

Eg = Energi celah pita

A = Absorpsi

ɣ = ½ , untuk *direct transition* (*direct semiconductor*)

2, untuk *indirect transition* (*indirect semiconductor*)

Setelah di dapat semua nilai, maka di buat grafik hubungan antara E (energi) dengan $(\alpha hv)^{ɣ}$, setelah itu ditarik garis lurus dan didapat nilai celah pita.