DAFTAR PUSTAKA

Abioye, Adekunle & Ani, F.N. 2015. Recent Development in the Production of Activated Carbon Electrodes from Agricultural Waste Biomass for Supercapacitors: A Review. *Renewable and Sustainable Energy Reviews,* **52** (1): 1282-1293.

Adetayo, Adeniji & Damilola Runsewe. 2019. Synthesis and Fabrication of Grafena and Grafena oksida: A Review. *Journal of Composite Materials*, **9**(3): 207-229.

Adijuwana, N. M., 1989. Teknik Spektroskopi dalam Analisis Biologi. Pusat Antar Universitas IPB: Bogor.

Allcott, Hunt & Nathan, W. 2014. Gasoline Prices, Fuel Economy, and The Energy Paradox. *NBER Working Paper*, **10**(2): 1853-1870

Amaliah, F., Sahara, & Fuadi, N., 2018. Pengaruh Temperatur terhadap Nilai Kapasitansi spesifik Elektroda Superkapasitor *Grafena* Berbasis Bambu Betung (*Dendrocalamus Asper*). *JFT,* **5**(2): 90-100.

Ardiani, Irma Septi. 2018. Sintesis Elektroda Superkapasitor dengan Pengaitan Fe^{3+}, Glukosa, dan Doping Nitrogen Menggunakan Metode Bubbling pada Grafena Oksida Tereduksi dari Tempurung Kelapa. Surabaya: Institut Teknologi Sepuluh November.

Arfandiani, D. & Larasati, D. 2013. Pemanfaatan Limbah Tempurung Kelapa Muda Melalui Pengembangan Desain Produk Alat Makan. *Jurnal Tingkat Sarjana Seni Rupa dan Desain*, **2**(1): 1-8.

Asep, Nugroho Suharto, 2011. Purwarupa Charger Baterai Multi Tegangan Berbasis Mikrokontroler at Mega 16. Yogyakarta: Universitas Gadjah Mada.

Bello, Sefiu Adekunle, Johnson, O., & Suleiman, B. 2015. Synthesized of Coconut Shell Nanoparticles Via a Top Down Approach: Assessment of Milling Duration on The Particle Sizes and Morphologies of Coconut Shell Nanoparticles. *Materials Letters,* **159**(10): 514-519.

Bera, Madhab, Chandrawati, Pragya, G., & Pradip, K. 2018. Facile One-Pot Synthesis of Grafena oksida by Sonication Assisted Mechanochemical Approach and Its Surface Chemistry. *Journal of Nanoscience and Nanotechnology,* **18**(15): 902-912.

Bledzki, A.K., A.A. Mamun., & J. Volk. 2010. Barley Husk and Coconut Shell Reinforced Polypropulene Composites: The Effect of Fibre Physical, Chemical, and Surface Properties. *Composites Science and Technology*, **70**(2): 840-846

Bhuyan, Sajibul Alam., Nizam Uddin, Maksudul Islam, Ferdaushi Alam Bipasha, & Sayed Shafayat Hossain. 2016. Synthesis of graphene. *Int Nano Lett*, **6**(5): 65-83.

Burke, Andrew. 2007. R & D Considerations for The Performance and Application of Electrochemical Capacitors. *Electrochimica Acta,* **53**(19): 1083-1091.

Cai, Chujiang, Nannan, S., Zhigang, S., & Xiaohu, Z. 2017. Facile and Size-Controllable Preparation of Grafena oksida Nanosheets Using High Shear Method and Ultrasonic Mehod. *Journal of Experimental Nanoscience,* **12**(12): 247-262.

Callister, Jr., & William, D., 2009. *Materials Science and Engineering an Introduction. 8th Edition*. New Jersey: John Wiley & Sons, Inc, Hoboken.

Chauhan, D.S., Quraishi, M.A., Ansari, K.R., & Saleh, T.A., 2020. Grafena and grafena oksida as new class of materials for corrosion control and protection: Present status and future scenario. *Progress in Organic*

Coatings, **147**(105): 1-23.
Chen, Hui, Yan, C., Fu, W., Gang, W., Pei, R., Xu, H., Bin, D., & Feng, Y. 2017. An Activated Carbon Derived from Tobacco Waste for Use As a Supercapacitor Electrode Material. *New Carbon Materials,* **32**(20): 592-599.
Chen, Ying-Chu, Yu, K., Yan, G., Yu, K., Ying Y., Li, C., & Kuei, H. 2011. Highly Flexible Supercapacitors with Manganese Oxide Nanosheet/Carbon Cloth Electrode. *Electrochimica Acta,* **56**(6): 7124-7130.
Cho, Young-Han, Jae, G.S., Jae, H.N., Da, Y.K., Yong, S.C., Tae, H.K., & Byoung, S.K. 2020. $CoMnO_2$-Decorated Polyimide-Based Carbon Fiber Electrodes for Wire-Type Asymmetric Supercapacitor Applications. *Molecules,* **25**(20): 56-83.
Choi, Hong Soo & Park, C.R. 2014. Theoretical Guidelines to Designing High Performance Energy Storage Device Based on Hybridization of Lithium-Ion Battery and Supercapacitor. *Journal of Power Sources*, **239**(120): 1-14
Cejka, J., Bekkum H., Corma, & Schuth, F. 2007. *Introduction of Science and Practice – 3rd Revised Edition*, 39-103.
Coros, M., C. Varodi, F. Pogacean, E. Gal, & S.M. Pruneanu. 2020. Nitrogen-Doped Graphene: The Influence of Doping Level on The Charge-Transfer Resistance and Apparent Heterogeneous Electron Transfer Rate. *Sensors,* **20**(9): 15-18.
Dan, Hongbing, Nan, L., Xing, X., Yue, G., Ying, H., Weiyan, Y., & Qinyan, Y. 2020. Mechanism of Sonication Time on Structure and Adsorption Properties of 3D Peanut Shell/Grafena oksida Aerogel. *Science of The Total Environment,* **739**(100): 139-983.
Deepan, P.G., Nisha, N.G., & Karthigeyan, A., 2014. Synthesis and characterization of nitrogen-doped grafena sheets by hydrothermal reduction method. *Int. J. Chemtech Res,* **7**(5): 1553–1558.
Dinata, A. A., Abel M. R., Syukri H., & Rahadian Z. 2018. Chemical Vapor Deposition: Process and Application. *Al-Kimiya,* **5**(4)*:* 53-57.
Ding, R., W. Li, X. Wang, T. Gui, B. Li, P. Han, H. Tian, A. Liu, X. Wang, X. & Liu, 2018. Abrief Review Of Corrosion Protective Films and Coatings based on Grafena and Grafena oksida. *Journal of Alloys and* Compounds, **764**(20): 1039-1055.
Ding, Zhiguo, Yuanwei, L., Jinho, C., Qi, S., Maged, E., Chih, L., & Vincent, P. 2017. Application of Non-Orthogonal Multiple Acces in LTE and 56 Network. A Manuscript Submitted to *The IEEE Communications Magazine*, **12**(3): 1-7
Dong, Yue, Jiayao, Z., Qiqi, L., Su, Z., Huaihe, S., & Dianzeng, J. 2020. Carbon Materials for High Mass-Loading Supercapacitors: Filling The Gap Between New Materials and Practical Applications. *Journal of Materials Chemistry A Issue,* **42**(20): 50-56.
Faiz, M.A., Azurahanim C., Yazid Y, Suriani A, & Ain M. 2020. Preparation and characterization of grafena oksida from tea waste and it's photocatalytic application of TiO_2/grafena nanocomposite, *Materials Research Express,* **7**(9): 15-20
Geng, Dongsheng, Songlan Y., Yong Z., Jinli Y., Jian L., Ruying L., Tsun-Kong S., Xueliang S., Siyu Y., & Shanna K.. 2011. Nitrogen Doping Effects on the Structure of Graphene. *Applied Surface Science* **257**(21): 9193–98.
Geim, A. K. & Novoselov, K. S. 2007. The Rise of Graphene. *Nature Materials*, **6**(2) : 1-14.
Girao, A. V., Caputo, G., & Ferro, M. C., 2017. Application of Scanning Electron Microscopy-Energy Dispersive X-Ray Spectroscopy (SEM-EDS). *Comprehensive Analytical Chemistry,* **75**(50): 153-168.

Gong, Y., Li, D., Fu, Q., & Pan, C. 2015. Influence of grafena microstructures on electrochemical performance for supercapacitors. Progress in Natural Science: *Materials International*, **25**(5), 379-385.

Halper, Marin & James, C. 2006. Supercapacitors: A Brief Overview. *MITRE Nanosystems Group,* **7**(4): 1-8

Hao, Junnan, Dong S., Songtao G., Aimei G., Chun H., Yayun Z., Yuqing L., Yulan H., & Jie Z.. 2016. Preparation of Three-Dimensional Nitrogen-Doped Grafena Layers by Gas Foaming Method and Its Electrochemical Capactive Behavior." *Electrochimica Acta* **193** (March): 293–301.

Hannan, M.A., Lipu, M.S.H., Hussain, A., & Mohamed, A., 2017. A Review of Lithium-Ion Battery State of Charge Estimation and Management System in Electric Vehicle Applications: Challenges and Recommendations. *Renewable and Sustainable Energy Review*, **78**(10); 834-854

Haq, S.F., Khanifah, N., Firliwati, Joni, M., dan Syakir, N., 2022. Perbandingan Karakteristik Sel Superkapasitor Berbahan Komposit GO/TiO_2 yang Dibuat Melalui Proses Termal dengan dan Tanpa Autoclave. *Jurnal Ilmu dan Inovasi Fisika*, **6**(2): 1-5

Heyrovska, Raji. 2016. The Coulombic Nature of the van der Waals Bond Connecting Conducting Grafena Layers in Graphite. *Graphene*, **5**(10): 35-38.

Ho, M.Y., Khiew, P., & Tan, T. 2014. A Review of Metal Oxide Composite Electrode Materials for Electrochemical Capacitors. *World Scientific,* **9**(6): 56-60

Ilhami, M.R. & Diah S. 2017. Pengaruh Massa Zn dan Temperatur Hydrotermal terhadap Struktur dan Sifat Elektrik Material Graphene. *Jurnal Sains dan Teknologi ITS*, **4**(2): 1-8

Indhumathy, M. & Prakasam, A. 2019. Controllable Synthesis of NIS/rGO Hybrid Composite: An Excellent Counter Electrode for Dye Sensitized Solar Cell. *Journal of Cluster Science,* **10**(2): 121-127.

Iro, Zaharaddeen, Subramani, C., Dash, S. 2016. A Brief Review on Electrode Materials for Supercapacitor. *Int. J. Electrochem. Sci,* **11**(12): 10628-10643.

Jayalaksmi, M. & Balasubramanian, K. 2008. Cyclic Voltammetric Behavior of Copper Powder Immobilized on Paraffin Impregnated Grafit Electrode in Dilute Alkali Solution. *Int. J. Electrochem. Sci.,* **3**(5): 1277-1287.

Junaidi, Muhamad & Diah, S. 2019. Pengaruh Variasi Waktu Ultrasonikasi dan Waktu Tahan Hydrothermal terhadap Struktur dan Konduktivitas Listrik Material Graphene. *Jurnal Teknik POMITS,* **3**(1): 1-10

Junaidi, Muhamad & Susanti, D. 2014. Pengaruh Variasi Waktu Ultrasonikasi dan Waktu Tahan Hydrothermal terhadap Struktur dan Konduktivitas Listrik Material Graphene. *Jurnal Teknik Pomits*, **3**(9): 1-6.

Jing, Lishuai, Elisabeth, DC., Petar, P., & Alex, OM. 2016. Design and Performance Analysis of Non-Coherent Detection Systems with Masiive Receiver Arrays. *APNet,* **4**(3): 11-20

Kementerian Pertanian Indonesia. 2019. *Produksi Kelapa Menurut Provinsi di Indonesia, 2015-2019*. Jakarta: Kementerian Pertanian Republik Indonesia.

Kiamahalleh, Meisam, Sharif, H., Ghasem, N., Suhairi, A., & Suraini, B. 2012. Multiwalled Carbon Nanotubes Based Nanocomposites for Supercapacitors: A Review of Electrode Materials. *World Scientific,* **7**(2): 10-15

Kim, Taeyoung & Jeyong, Y. 2015. CDI Ragone Plot As a Functional Tool to Evaluate Desalination Performance in Capacitive Deionization. *RSC Advanced*, **5**(20): 1456-1461.

Kouchachvili, Lia, Wahiba, Y., & Evgueniy, E. 2018. Hybrid Battery/Supercapacitor Energy Storage System for The Electric Vehicles. *Journal of Power Sources,* **374**(20); 237-248.

Li, Jianchang., Xiangqiong Zeng, Tianhui Ren, & Emile van der Heide. 2014. The Preparation of Grafena oksida and Its Derivatives and Their Application in Bio-Tribological Systems. *Lubricants*, **2**(2): 137-161.

Lin, X.-Q., Wang, W.-D., Lü, Q.-F., Jin, Y.-Q., Lin, Q., & Liu, R. 2017. Nitrogen-doped graphene/carbon nanohorns composite as a high-performance supercapacitor electrode. *J. Mater. Sci. Technol.* **33**(30): 1339–1345.

Liu, Dong, Jun, S., Nianping, L., Huiyu, Y., & Ai, D. 2013. Preparation of Activated Carbon Aerogels with Hierarchically Porous Structures for Electrical Double Layer Capacitors. *Electrochimica Acta*, **89**(25): 571-576.

Luo, Gui Yang, Yuan, L., Zi, L., Yong, L., Fu, Z., Yi, M., Xin, Y., & Yong, D. 2021. Electrochemical Performance of in Situ LiFePO4 Modified by N-Doped Grafena for Li-Ion Batteries. *Ceramics International,* **47**(9): 11332-11339.

Lyn, Han, Chin, P., Zawawi, R., & Nur, H. 2021. Effect of Sonication Time and Heat Treatment on The Structural and Physical Properties of Chitosan/Grafena oksida Nanocomposite Films. *Food Packaging and Self Life,* **28** (7): 80-90

Marcelina, V., Fitri, Y., & Yeni, W. 2017. Pembuatan Lapisan Tipis Oksida Grafena Tereduksi sebagai Material Elektroda Sistem Kapasitor dan Karakterisasinya. *Jurnal Fisika dan Aplikasi*, **1**(3): 112-114

Masthura & Zulkarnain P. 2018. Karakterisasi Mikrostruktur Karbon Aktif Tempurung Kelapa dan Kayu Bakau. *Journal of Islamic Science and Technology*, **4**(1): 70-90

Meng, Xianhe, Chubin, W., Xiao, P., & Xin, J. 2018. Rodlike CeO2/Carbon Nanocomposite Derived from Metal-Organic Frameworks for Enhanced Supercapacitor Applications. *Journal of Material Science,* **53**(50): 13966-13975.

Mulyani, R., Buchari, Noviandri, & Ciptati, 2012. Studi Voltametri Siklik Sodium Dodecyl Benzen Sulfonat dalam Berbagai Elektroda dan Elektrolit Pendukung. *Teknologi Pengelolaan Limbah,* **15**(1): 51-56.

Naderi, Leila, Saeed, S., & Francesca, S. 2020. Fabrication of a 2.8 V High-Performance Aqueous Flexible Fiber-Shaped Asymmetric Micro-Supercapacitor Based on MnO_2/PEDOT: PSS-Reduced Grafena oksida Nanocomposite Grown on Carbon Fiber Electrode. *Journal of Materials Chemistry,* **8**(10): 19588-19602.

Najati, B.L., Junita, T.K., Norman, S., & Fitrilawati. 2023. Characteristics of Grafena Like Material Synthesized from Coconut Shell Charcoal Powder Using Solid State Method. *Jurnal Ilmu dan Inovasi Fisika*, **7** (3): 30-40.

Najib, Sumaiyah & Emre, E. 2019. Currect Progress Achieved in Novel Materials for Supercapacitors Electrodes: Mini Review. *Royal Society of Chemistry*, **1**(4): 2817-2827.

Nascimento, P.F.P., Eduardo, E.S. Pereira, J.F. Silva. 2020. Cu^{2+} & Cd^{2+} Adsorption Mechanism by Coconut Husk Powder with and without Amine Modification. *J. Environ. Eng* **146**(8): 100-110

Ngidi, Nonjabulo, Moses, A., & Vincent, O. 2019. Effect of Doping Temperatures and Nitrogen Precursors on The Physicochemical, Optical, and Electrical Conductivity Properties of Nitrogen-Doped Reduced Grafena oksida. *Materials,* **12**(11): 3376-3380

Nikoloski, Krume. 2016. Technology and Economic Development: Restrospective. *JPMNT,* **4**(4): 16-20

Ningsih, S.K.W. 2016. *Sintesis Organik*. Padang: UNP Press Padang

Osman, A., Elhakeem, A., Kaytbay, S., & Ahmed, A., 2021. Thermal, Electrical and Mechanical Properties of Graphene/Nano-Alumina/Epoxy Composites. *Materials Chemistry and Physics,* **257**(2): 123809-123815.

Pinto, H., & Markevich, A. 2014. Electronic and Electrochemical Doping of Grafena by Surface Adsorbates. *Beilstein Journal of Nanotechnology*, **6**(2): 1842-1848.

Pratama, Andre, Lia D., & Adhitiyawarman, 2021. Sintesis Titanium Oksida/Reduced Grafena oksida (TiO_2/rGO) Untuk Fotokatalisis Bahan Pewarna Metilen Biru. *Jurnal Teknik Kimia*, **10**(2): 90-100

Purkait, Taniya, Guneet, S., Dinesh, K., Mandeep, S., & Ramendra, S. 2018. High-Performance Flexible Supercapacitors Based on Electrochemically Tailored Three-Dimensional Reduced Grafena oksida Networks. *Scientific Reports*, **8**(6): 640-645

Putri, N.A., & Z.A.I. Supardi. 2023. Sintesis dan Karakterisasi Grafena oksida (GO) dari Bahan Alam Tempurung Kelapa. *IFI,* **12**(2): 47-55.

Rahayu, P., Putri N.P., & Rohmawati L., 2017. Karakteristik Reduced Grafena oksida (rGO) Berbahan Dasar Limbah Batang Padi. *Sains & Matematika*, **6**(1): 26-31.

Rajkumar, Muniyandi, Chun, T.,Tzu, H., Ming, G., & Chi, C. 2015. Advanced Materials for Aqueous Supercapacitors in The Asymmetric Design. *Progress In Natural Science: Materials International,* **25**(10): 527-544.

Rosi, M. & Viridi, S. 2018. Design and Fabrication of a Simple Laboratory Ball Mill for Powder Coconut Shell Preparation as Raw Material of Biocher. *Materials Science and Engineering,* **9**(2): 15-20

Shao, G., Lu, Y., Wu, F., Yang, C., Zeng, F., & Wu, Q. 2012. Grafena oksida: The Mechanisms of Oxidation and Exfoliation. *J. Mater. Sci,* **10**(3): 4400-4409.

She, Liaona, Qi, L., Feng, Z., Liping, K., Xuexia, H., Jie, S., Zhibin, L., & Zong, H.L. 2020. Sulfur Doping Induced Anionic Oxidation of Niobium-Pentoxide-Based Anode for Ultralong-Life and High Energy-Density Na-Ion Capacitors. *Journal of Power Sources*, **45**(21): 227-244.

Shen, Hallong, Xiaochun, W., Zhenqi, C., Dan, L., Man, C., Haifu, H., & Wenzheng, Z. 2022. Synthesis of Nitrogen-Doped Grafena Driven from Photothermal Decomposition of Ammonium Bicarbonate and Its Application in Supercapacitors. *Journal of Energy Storage*, **56**(6): 105-134.

Si, A., Kyzas, G. Z., Pal, K., & De Souza Jr., F. G. (2021). Grafena Functionalized Hybrid Nanomaterials for Industrial-Scale Applications: A Systematic Review. *Journal of Molecular Structure*, **12**(39): 130-138.

Siti, I. N., 2020. Isolasi dan Karakterisasi alfa-Selulosa dari Tumbuhan Alang-Alang (*Imperata Cylindrical*) Sebagai Bahan Mikrofilter. Yogyakarta: Universitas Islam Indonesia.

Skoog, D. A., Holler, F. J., West, D. M., & Crouch, S. R., 2013. *Fundamental of Analytical Chemistry Ninth Edition*, Brooks Cole: USA.

Suhartana. 2007. Pemanfaatan Tempurung Kelapa sebagai Bahan Baku Arang Aktif dan Aplikasinya Untuk Penjernihan Air Limbah Industri Petis di Tambak Lorok Semarang. *Momentum*, **3**(2): 1-10

Sujiono, E.H., et al. 2022. Fabrication and Characterization of Coconut Shell Activated Carbon Using Variation Chemical Activation for Wastewater Treatment Application. *Result In Chemistry,* **4**(1): 100-291.

Sujiono, E.H., et al. 2020. Grafena oksida Based Coconut Shell Waste: Synthesis by Modified Hummers Method and Characterization. *J. Heliyon,* **6**(5)*:* 45-68.

Sun, H., Ren Z, Ling L, Memon S, Ren J, & Liu B. 2020. Influence of grafena oksida on interfacial transition zone of mortar. *Journal of Nanomaterials*, **20**(20): 21-30

Suslick, K.S. & Price, G.J. 1999. Applications of Ultrasound to Materials Chemistry. *Annu. Rev: Mater*. Sci, **19**(29): 295: 326.

Tetra, Olly Norita, Hermansyah, A., Syukri, S., Bustanul, A., & Asih, N. 2018. Pengaruh Penambahan Karbon Aktif dari Tanah Gambut Terhadap Kapasitansi spesifik Elektroda Superkapasitor Berbahan Dasar Karbon Aktif Cangkang Kelapa Sawit. Padang: Universitas Andalas.

Thebora, M. E. S., Ningsih, K. N., & Shalihin, M. I., 2019. Sintesis Grafena dari Limbah Pelepah Sawit (*Elaeis* Sp.) dengan Metode Reduksi Grafit Oksida menggunakan Pereduksi Zn. *Khazanah Intelektual,* **3**(2): 462-476.

Vangari, Manisha, Tonya, P., & Li, J. 2012. Supercapacitors: Review of Materials and Fabrication Methods. *Journal of Energy Engineering,* **139**(2): 15-20

Vietanti, F., N. Saidatin, S. Arinda & K. Riyadi. 2021. Pengaruh Doping Nitrogen pada Matriks Reduced Grafena oksida Terhadap Sifat Kapasitif Superkapasitor. *SENANTITAN 1* ISSN 2775-5630.

Wachid, F.M. 2012. *Analisis Kandungan Fasa Karbon pada Proses Pemanasan Tempurung Kelapa*. Surabaya: Jurusan Fisika FMIPA ITS.

Wahyuningsih, S., Ramelan, A.H., Fuad, M., & Hanif, A. Q., 2020. Sintesis Grafena Oksida Tereduksi Terdoping Nitrogen dan Sulfur dari Amonium Tiosianat Sebagai Elektroda Lawan Pada Sistem *Dye Sensitized Solar Cell* (DSSC). *ALCHEMY Jurnal Penelitian Kimia*, **16**(1):126-139.

Wang, C., Zhou J., & Du F. 2016. Synthesis of highly reduced grafena oksida for supercapacitor. *Journal of Nanomaterials,* **20**(16): 60-70

Wang, Lan, Zhiyong, G., Jiuli, C., Xiao, L., Dapeng, W., Fang, X., Yuming, G., & Kai, J. 2015. Nitrogen-doped Porous Carbons As Electrode Materials for High-Performance Supercapacitor and Dye-Sensitized Solar Cell. *ACS Applied Materials and Interfaces,* **5**(6)*:* 20234-20244.

Wang, Xiaohong, Xin, L., Chengxiang, H., Chen, H., Cunwang, G., & Yaning, G. 2020. Fabrication of NiCoAl-Layered Double Hydroxide/N-GO for High Energy All-Solid-State Asymmetric Supercapacitors. *Applied Surface Science,* **2**(5): 146-191.

Wang, Xuewan, Gengzhi S, Parimal R, Dong H, Wei H, & Peng C. 2014. Heteroatom-Doped Grafena Materials: Syntheses, Properties and Applications. *Chem. Soc. Rev.* **43**(20): 7067–7098.

Wu, Yunpeng, Yi, F., Zhongyu, H., Deyang, Y., Ying, X., & Xiaoyang, L. 2021. Facile Preparation of Hydrogenated Grafena by Hydrothermal Methods and The Investigation of Its Ferromagnetism. *Chinese Chemical Letters,* **5**(10): 8-13

Xiang, Z., Zhou, X., Wan, G., Zhang, G., & Cao, D., 2014. Improving Energy Conversion Efficiency of Dye-Sensitized Solar Cells by Modifying TiO_2 Photoanodes with Nitrogen-Reduced Grafena oksida. *ACS Sustainable Chemistry and Engineering,* **2**(5): 1234-1240.

Xie, Yibing & Zhou, Y. 2019. Enhanced Capacitive Performance of Activated Carbon Paper Electrode Material. *Journal of Materials Recearch,* **34**(2): 2472-2481.

Xu, Yanyan., Huizhe Cao, Yankin Xue, Biao Li & Weihua Cai. 2018. Liquid-Phase Exfoliation of Graphene: An Overview on Exfoliation Media, Techniques, and Challenges. *Nanomaterials*, **8**(1): 942-948

Yadav, Roshni, & C.K. Dixit. 2017. Synthesis, Characterization and Prospective Applications of Nitrogen-Doped Graphene: A Short Review. *Journal of Science: Advanced Materials and Devices* **2**(2): 141–49.

Yang, Zhi, Feng, Z., Hong, T., Jie, G., & Zhong, S. 2022. Controllable Synthesis of 2D Mesoporous Nitrogen-Doped Carbon/Grafena Nanosheets for High-Performance Micro-Supercapacitors. *New Carbon Materials,* **37**(2): 936-943.

Ye, Shibing & Jiachun, F. 2016. The Effect of Sonication Treatment of Grafena oksida on The Mechanical Properties of The Assembled Films. *RSC Advances*, **10**(10): 1-8

Yusoff, F., Khing, N. T., Hao, C. C., Sang, L.P., Muhamad, N.B., & Saleh, Md. N, 2018. The Electrochemical Behavior of Zinc Oxide/Reduced Grafena oksida Composite Electrode in Dopamine. *Malaysian Journal of Analytical Sciences,* **22**(2): 227-237.

Zafar, Muhammad, Yang, L., Scarlett, A., & Mohan, V. 2022. Electrochemical Sensing of Oxalic Acid Using Silver Nanoparticles Loaded Nitrogen-Doped Grafena oksida. *Carbon Trends,* **8**(2): 100-188.

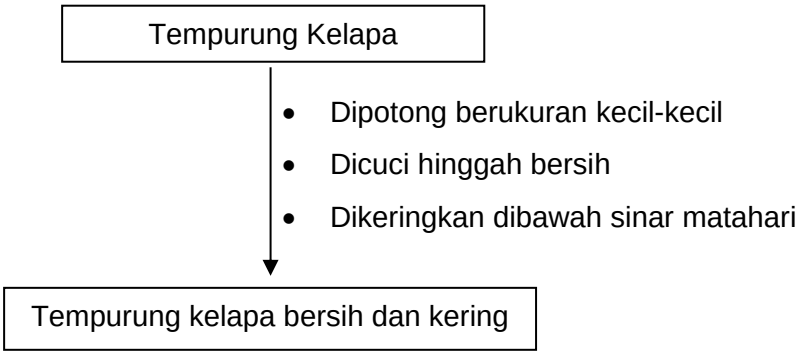
Zaman, K. 2021. *Pengaruh Grafena oksida (GO) Grafit Pensil sebagai Additive untuk Meningkatkan Strength Semen Pemboran.* Pekanbaru : Universitas Islam Riau.

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.

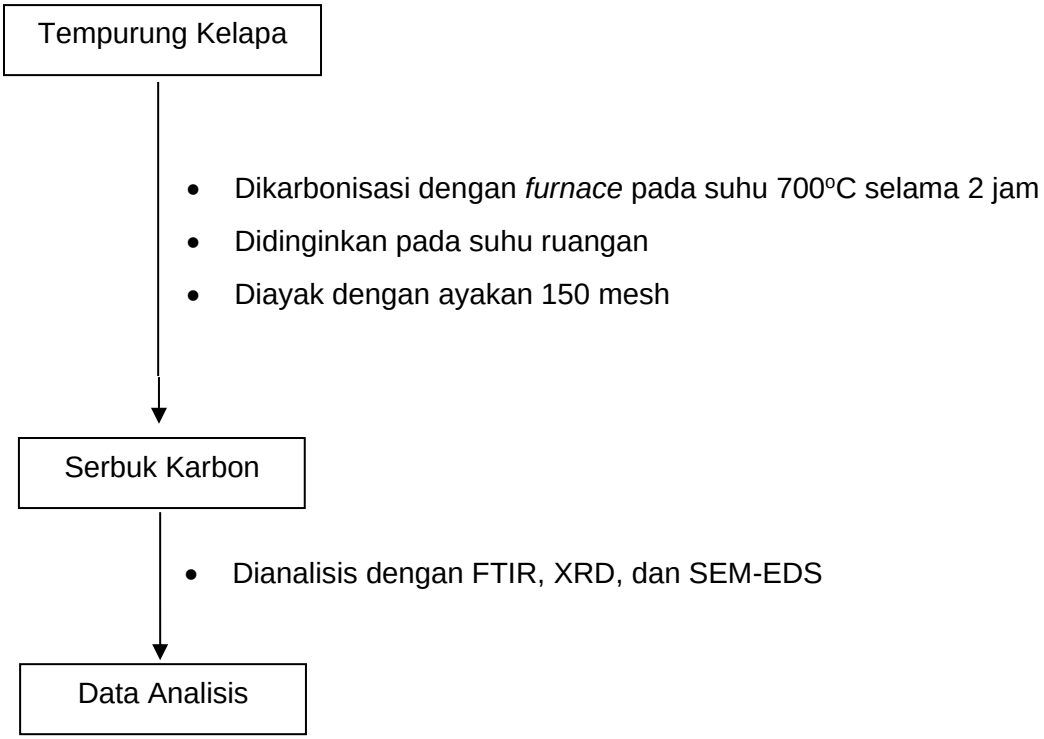
LAMPIRAN-LAMPIRAN

Lampiran 1. Skema Prosedur Kerja Penelitian

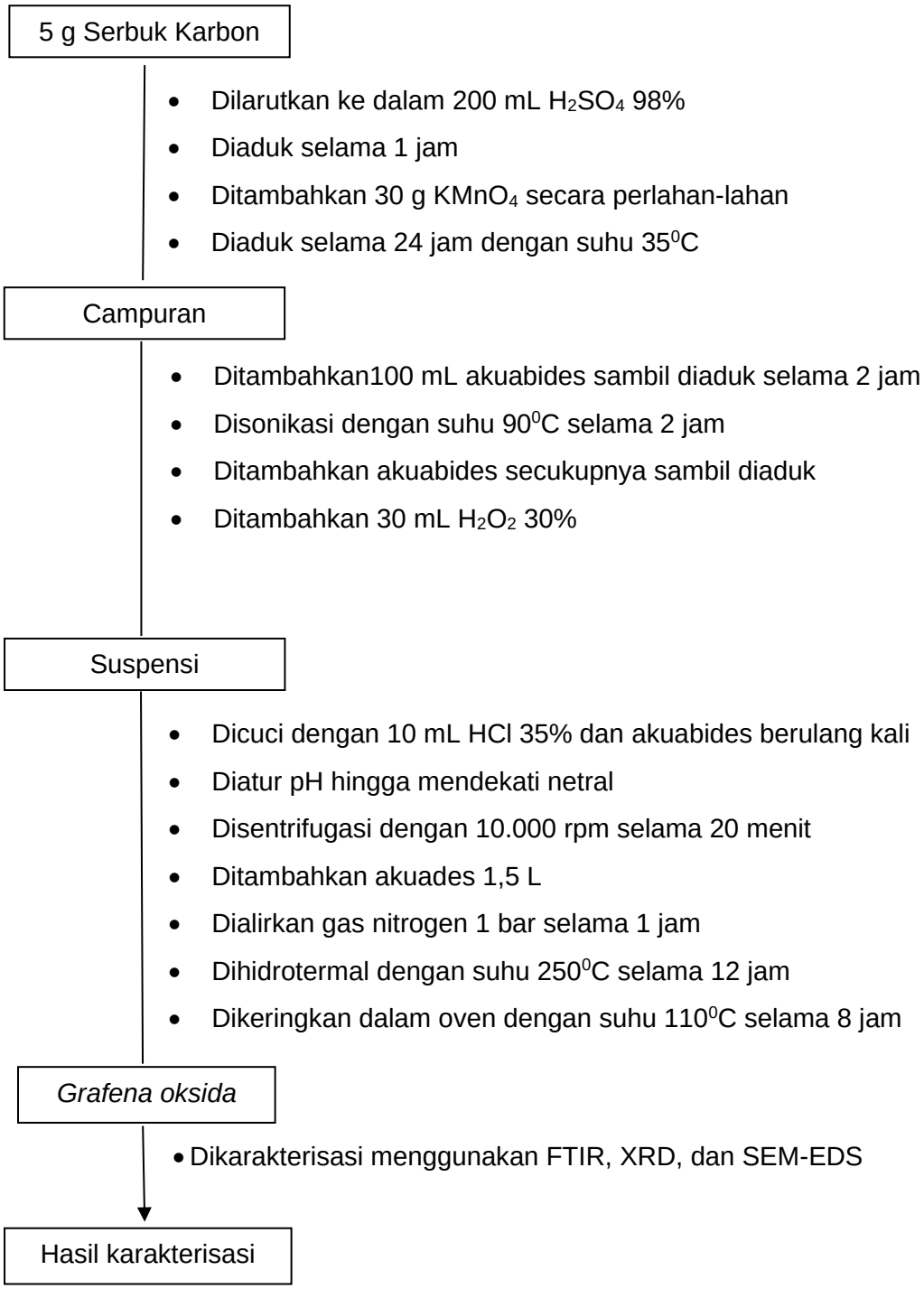
1.1. Preparasi Sampel



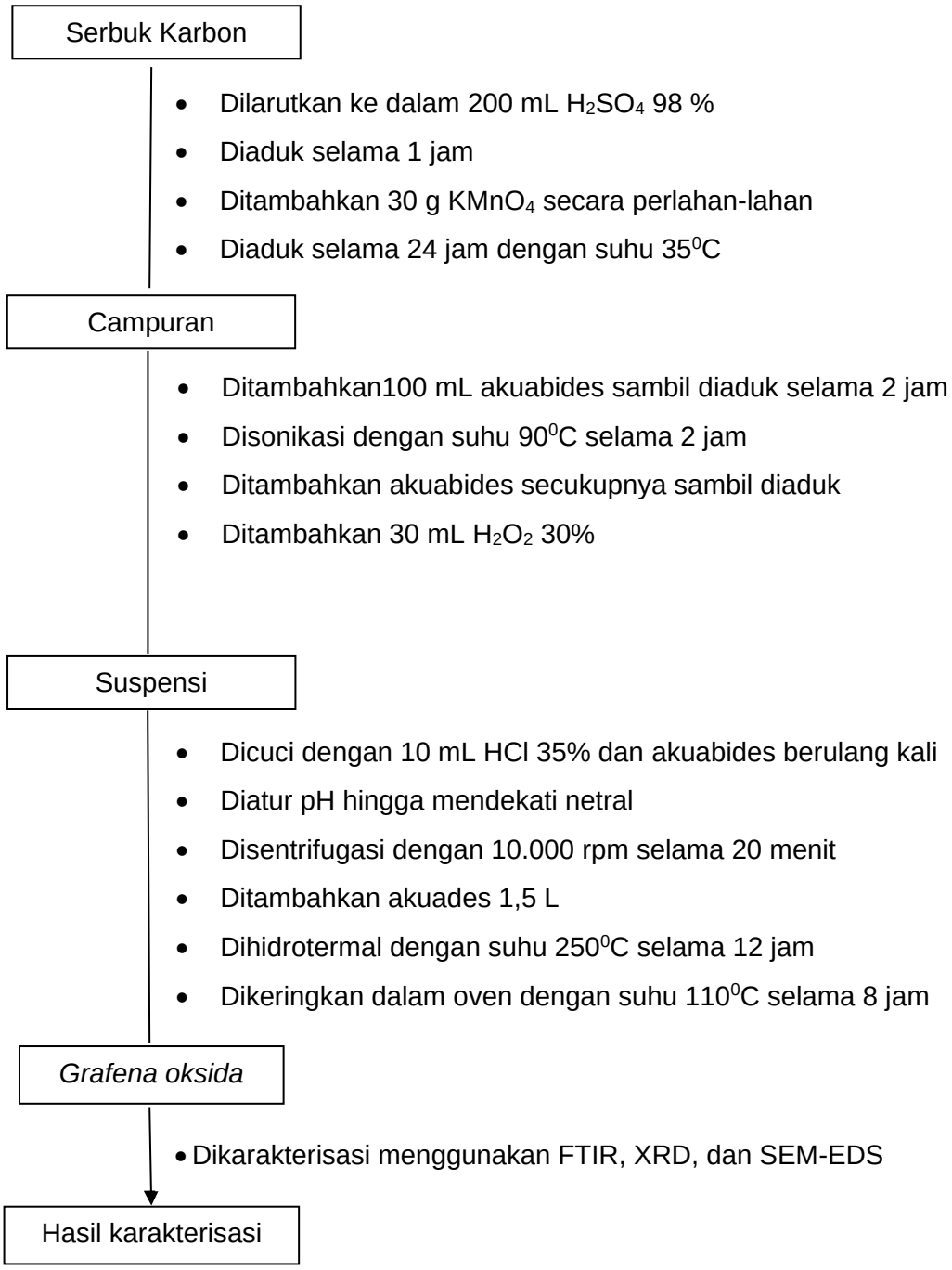
1.2. Proses Karbonisasi



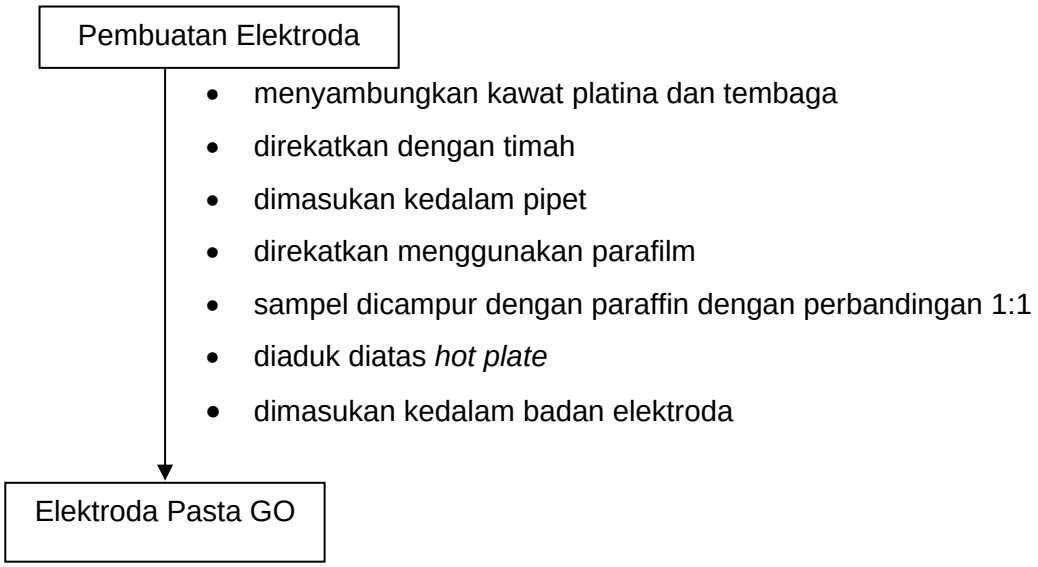
1.3. Sintesis *Grafena Oksida* (GO) dengan Metode Sonikasi dan Hidrotermal Menggunakan Injeksi Gas Nitrogen



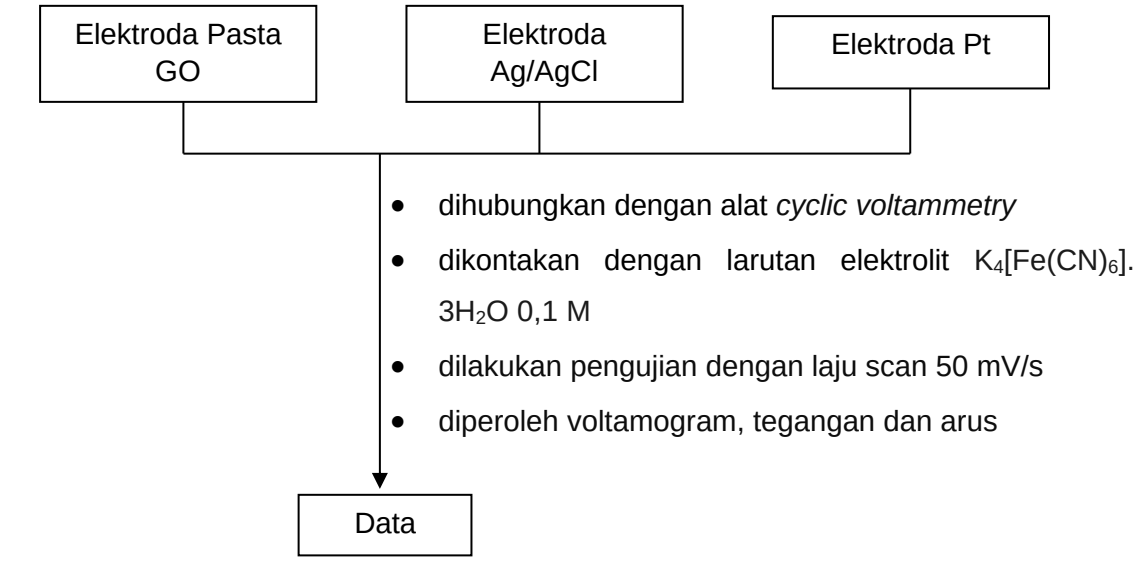
1.4. Sintesis *Grafena Oksida* (GO) dengan Metode Sonikasi dan Hidrotermal tanpa Menggunakan Injeksi Gas Nitrogen



1.5. Pembuatan Elektroda dan Pasta Elektroda GO



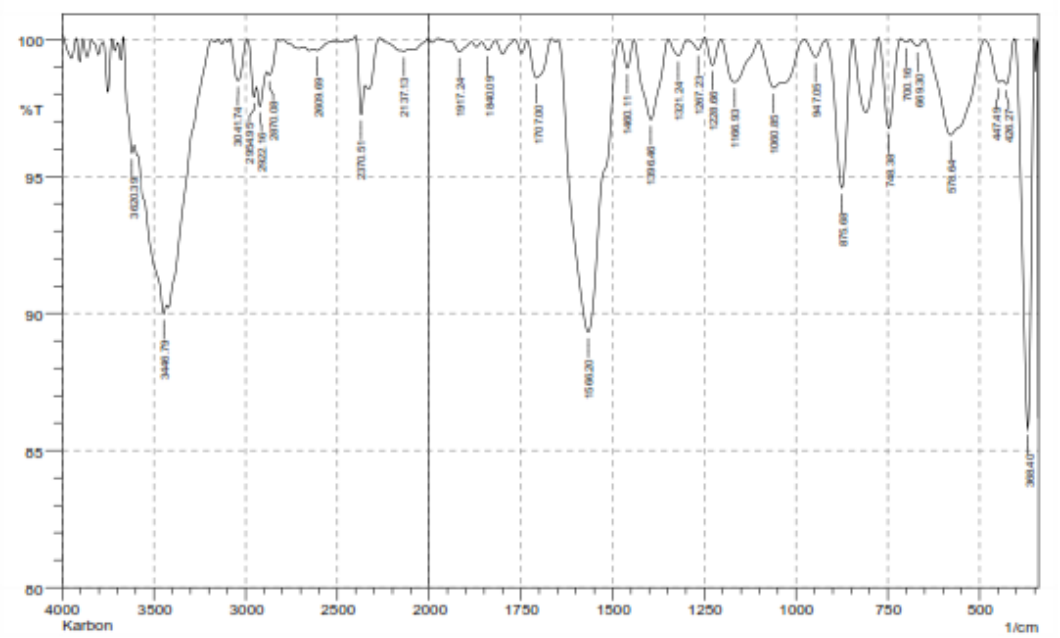
1.6. Pengukuran Nilai Kapasitansi Spesifik



Lampiran 2. Data Hasil FTIR

2.1. Sampel Karbon

SHIMADZU



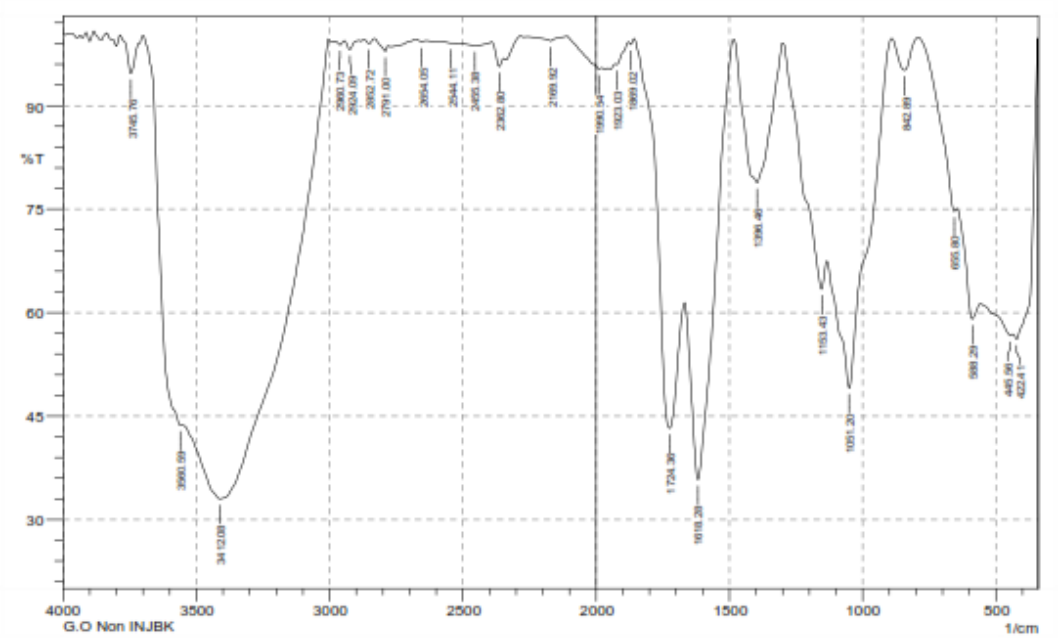
No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	366.4	85.792	14.227	403.12	351.04	1.696	1.699
2	426.27	96.366	0.7	437.64	406.98	0.157	0.056
3	447.49	96.434	0.363	466.06	437.64	0.166	0.024
4	578.64	96.507	3.46	646.15	466.06	1.425	1.403
5	669.3	99.74	0.236	686.66	646.06	0.025	0.02
6	700.16	99.697	0.1	713.66	686.66	0.007	0.006
7	748.36	96.754	3.267	775.36	713.66	0.403	0.413
8	875.68	94.572	5.4	920.05	846.75	0.804	0.795
9	947.05	99.349	0.622	977.91	920.05	0.053	0.076
10	1060.65	96.23	0.663	1103.26	1039.63	0.33	0.096
11	1166.93	96.435	1.524	1205.51	1103.26	0.395	0.372
12	1225.66	99.053	0.976	1247.94	1205.51	0.069	0.094
13	1267.23	99.618	0.396	1294.24	1247.94	0.036	0.037
14	1321.24	99.405	0.573	1346.24	1296.09	0.073	0.069
15	1396.46	97.063	2.926	1440.63	1346.24	0.655	0.652
16	1460.11	96.946	1.026	1479.4	1440.63	0.056	0.063
17	1566.2	89.316	10.632	1647.21	1481.33	4.314	4.279
18	1707	96.59	1.402	1732.06	1666.5	0.242	0.242
19	1840.09	99.604	0.316	1857.45	1816.87	0.039	0.027
20	1917.24	99.536	0.374	1940.39	1864.45	0.066	0.044
21	2137.13	99.56	0.049	2156.42	2106.2	0.056	0.005
22	2370.51	97.257	1.791	2401.36	2349.3	0.354	0.175
23	2609.69	99.566	0.109	2630.91	2526.75	0.115	0.016
24	2670.08	96.692	0.404	2685.51	2623.79	0.233	0.067
25	2922.16	97.546	0.697	2941.44	2885.51	0.462	0.102
26	2954.95	97.694	0.549	2969.66	2941.44	0.253	0.069
27	3041.74	96.492	1.516	3054.16	2969.66	0.327	0.33
28	3446.79	89.956	8.625	3606.69	3431.36	5.742	0.345
29	3620.39	95.85	1.166	3666.66	3606.69	0.722	0.217

Comment;
Karbon

Date/Time; 3/2/2023 4:31:25 PM
No. of Scans;

2.2. *Grafena Oksida* (GO) Non Injeksi

SHIMADZU



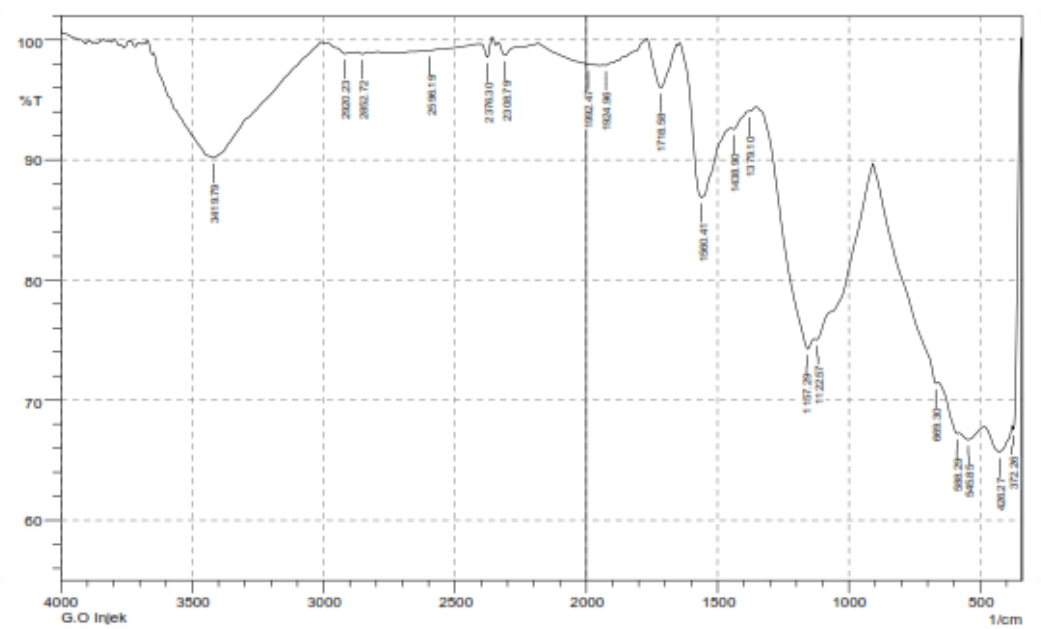
	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	341.4	4.6616	47.4662	343.33	339.47	5.0434	1.2715
2	422.41	56.1596	6.6965	435.91	345.26	17.6246	6.3627
3	445.56	56.671	0.4767	557.43	437.84	27.2629	0.0752
4	586.29	59.0741	6.796	646.15	559.36	16.3152	1.635
5	655.8	74.6957	1.7013	790.81	648.08	7.6661	0.1697
6	842.69	95.1429	4.657	869.16	792.74	1.1042	1.0225
7	1051.2	49.0662	29.3961	1134.14	891.11	40.9562	20.2372
8	1153.43	63.4261	7.3106	1300.02	1136.07	17.4175	2.9246
9	1396.46	76.5556	20.4911	1463.26	1301.95	11.0672	10.5589
10	1618.28	35.6036	35.7037	1666.5	1465.19	41.2594	22.1046
11	1724.36	43.2435	29.5006	1857.45	1666.43	32.4463	12.9626
12	1869.02	96.6679	0.569	1876.67	1857.45	0.0739	0.0239
13	1923.03	95.9731	0.4197	1926.82	1876.67	0.5751	0.047
14	1990.54	95.3015	0.5656	2106.2	1976.97	1.51	0.2033
15	2169.92	99.3519	0.6752	2256.64	2106.2	0.145	0.1576
16	2362.8	95.6766	1.9957	2391.73	2347.37	0.5706	0.1672
17	2455.36	96.6664	0.4515	2497.62	2391.73	0.5314	0.1327
18	2544.11	99.0724	0.0126	2562.66	2542.16	0.1425	0.0021
19	2654.05	99.2426	0.2266	2677.2	2640.55	0.0956	0.016
20	2791	97.5636	0.9353	2833.43	2763.26	0.2717	0.0933
21	2852.72	96.9773	0.6554	2870.06	2833.43	0.111	0.0531
22	2924.09	96.1367	1.2763	2945.3	2869.37	0.2617	0.1196
23	2960.73	96.8129	0.5427	2976.16	2945.3	0.1245	0.0378
24	3412.06	33.0205	25.2009	3554.61	3005.1	170.2347	71.3141
25	3560.59	43.6836	1.554	3699.47	3556.74	27.3492	1.7427
26	3745.76	94.6695	4.6571	3766.27	3714.9	0.7535	0.6367

Comment;
G.O Non INJBK

Date/Time; 10/5/2023 12:10:30 PM
No. of Scans;

2.3. *Grafena Oksida* (GO) Injeksi Gas Nitrogen

SHIMADZU



No.	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	341.4	36.556	30.656	343.33	339.47	1.593	0.401
2	372.26	67.56	4.166	376.12	345.26	2.913	0.492
3	426.27	65.655	2.141	464.13	376.05	16.756	0.669
4	545.65	66.719	0.725	576.64	466.06	16.02	0.232
5	588.29	67.219	0.459	657.73	580.57	12.367	0.114
6	669.3	71.394	0.793	905.47	659.66	25.02	0.901
7	1122.57	75.051	0.679	1132.21	910.4	20.662	1.635
8	1157.29	74.263	2.663	1352.1	1134.14	17.333	1.545
9	1379.1	94.048	0.054	1382.96	1354.03	0.752	0.006
10	1438.9	92.557	0.193	1444.68	1384.89	1.603	0.021
11	1560.41	86.667	0.654	1643.35	1556.55	2.73	0.233
12	1718.58	96.02	3.653	1766.72	1656.85	1.123	1.047
13	1924.96	97.679	0.147	1936.46	1859.36	0.644	0.035
14	1992.47	97.945	0.068	2163.42	1966.68	1.162	0.157
15	2308.79	96.704	1.071	2335.8	2163.42	0.434	0.272
16	2376.3	96.557	1.406	2399.45	2356.94	0.132	0.116
17	2596.19	99.12	0.005	2596.12	2547.97	0.179	0
18	2852.72	96.619	0.156	2872.01	2831.5	0.194	0.013
19	2920.23	96.637	0.306	2991.59	2895.15	0.324	0.043
20	3419.79	90.19	9.002	3645.46	3010.66	15.735	13.666

Comment;
G.O Injek

Date/Time; 12/11/2023 11:49:21 AM
No. of Scans;

Lampiran 3. Data Hasil XRD

3.1. Sampel Karbon

```
# Data Infomation
          Group                : Standard
          Data                 : karbon130323
          Sample Nmae          : serbuk
          Comment              :
          Date & Time          : 03-14-23 08:48:31

# Measurement Condition
    X-ray tube
          target               : Cu
          voltage              : 40.0 (kV)
          current              : 30.0 (mA)
    Slits
          Auto Slit            : not Used
          divergence slit      :   1.00000 (deg)
          scatter slit         :   1.00000 (deg)
          receiving slit       :   0.30000(mm)
    Scanning
          drive axis           : Theta-2Theta
          scan range           :   15.0000 - 75.0000 (deg)
          scan mode            : Continuous Scan
          scan speed           :    2.0000 (deg/min)
          sampling pitch       :    0.0200 (deg)
          preset time          :    0.60 (sec)
```

3.2. *Grafena Oksida* (GO) Non Injeksi

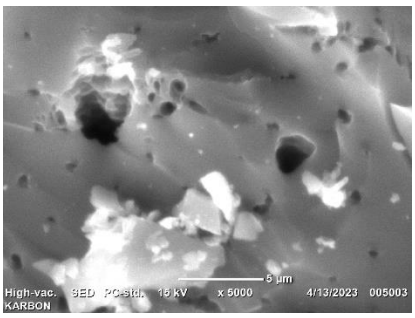
```
////////////////////////////////////////////////////////////////////////////////
/// Profile Data Ascii Dump (XRD)                                            ///
////////////////////////////////////////////////////////////////////////////////

  Group     : KENSA
  Data      : GO-90M
  File Name : GO-90M.RAW

# Profile Datafile
          comment              = 5-80
          date & time          = 04-13-23 13:53:09

# Measurement Condition
    X-ray tube
          target               = Cu
          voltage              = 40.0 (kV)
          current              = 30.0 (mA)
    Slits
          divergence slit      = 1.00000 (deg)
          scatter slit         = 1.00000 (deg)
          receiving slit       = 0.15000 (mm)
    Scanning
          drive axis           = Theta-2Theta
          scan range           =    5.000 -   80.000
          scan mode            = Continuous Scan
          scan speed           =   2.0000 (deg/min)
          sampling pitch       =   0.0200 (deg)
          preset time          =   0.60 (sec)
```

3.3. *Grafena Oksida* (GO) Injeksi

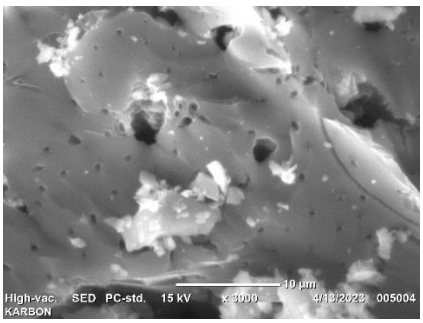
```
////////////////////////////////////////////////////////////////////////////////
///     Profile Data    Ascii   Dump    (XRD)   ///
////////////////////////////////////////////////////////////////////////////////

        Group   :       KENSA
        Data    :       GO-INJEKSI
        File    Name    :       GO-INJEKSI.RAW

#       Profile Datafile
        comment =       May-80
        date    &       time    =       9/22/2023       9:45:33

#       Measurement     Condition
        X-ray   tube
        target  =       Cu
        voltage =       40      (kV)
        current =       30      (mA)
        Slits
        divergence      slit    =       1       (deg)
        scatter slit    =       1       (deg)
        receiving       slit    =       0.15    (mm)
        Scanning
        drive   axis    =       Theta-2Theta
        scan    range   =       5       -       80
        scan    mode    =       Continuous      Scan
        scan    speed   =       2       (deg/min)
        sampling        pitch   =       0.02    (deg)
        preset  time    =       0.6     (sec)
```

Lampiran 4. Data Hasil SEM-EDS

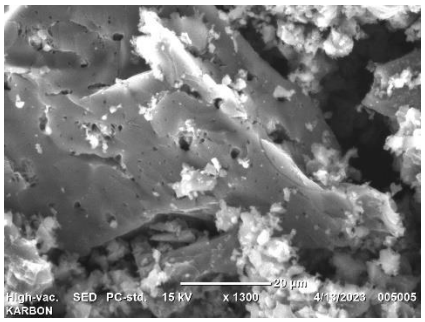
4.1. Sampel Karbon



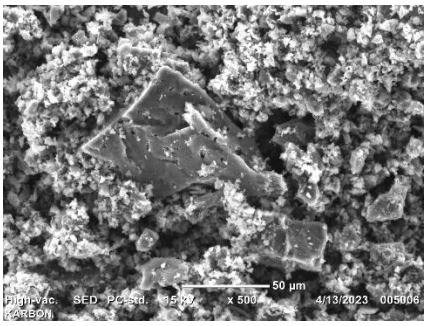
Perbesaran 5.000 x



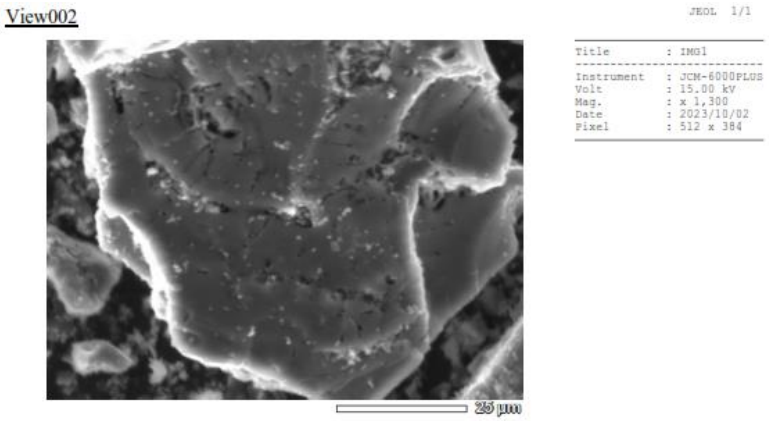
Perbesaran 3.000 x

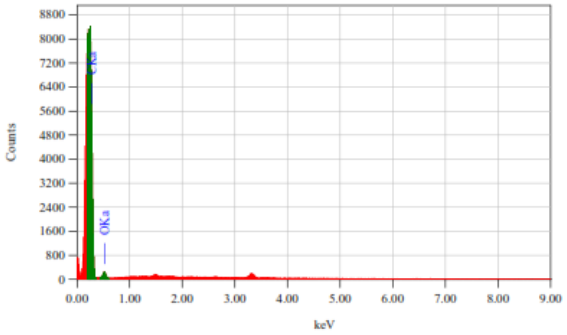


Perbesaran 1.300x



Perbesaran 500x

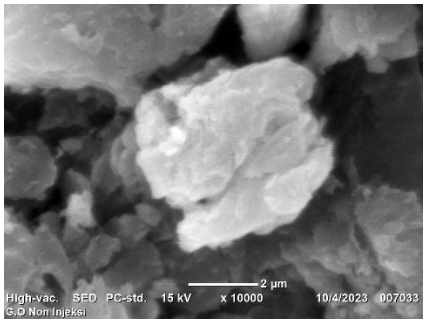




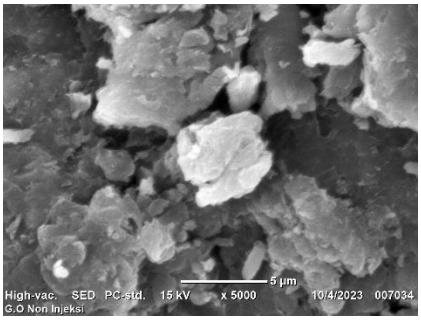

```
Acquisition Parameter
Instrument   : JCM-6000PLUS
Acc. Voltage : 15.0 kV
Probe Current: 1.00000 nA
PHA mode     : T3
Real Time    : 51.01 sec
Live Time    : 50.00 sec
Dead Time    : 1 %
Counting Rate: 3161 cps
Energy Range :  0 - 20 keV
```

```
Thin Film Standardless  Standardless Quantitative Analysis(Oxide)
Fitting Coefficient : 0.8402
Total Oxide : 24.0
Element        (keV)   Mass%    Counts   Sigma    Mol%  Compound   Mass%  Cation        K
 C K  (Ref.)   0.277  100.00  12822.44    0.55  100.00  C          100.00    0.00   1.0000
 O                      0.00                             ND
Total                 100.00                  100.00          100.00    0.00
```

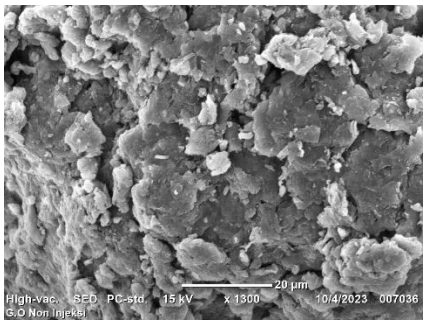
4.2. *Grafena Oksida* (GO) Non Injeksi



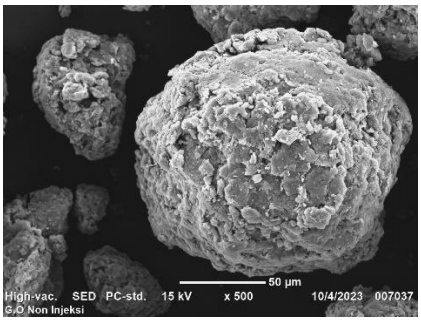
Perbesaran 10.000x



Perbesaran 5.000x

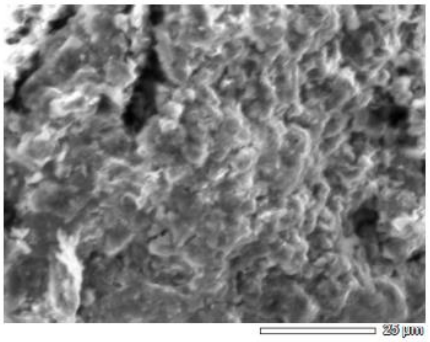


Perbesaran 3.000x

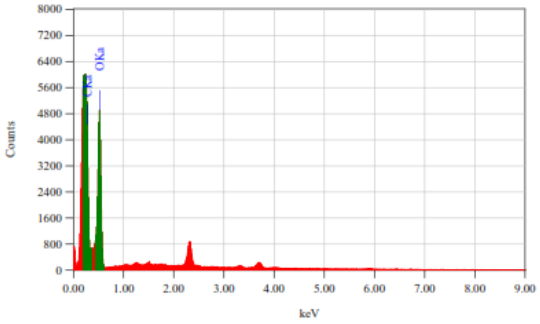


Perbesaran 500x

View001




```
JEOL  1/1
Title       : IMG1
Instrument  : JCM-6000PLUS
Volt        : 15.00 kV
Mag.        : x 1,300
Date        : 2023/10/02
Pixel       : 512 x 384
```

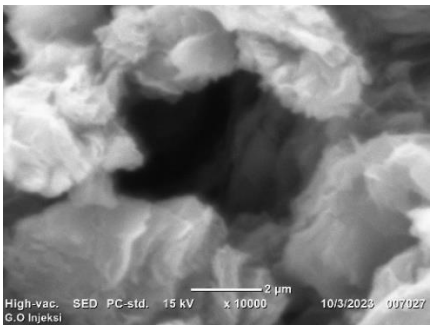


Acquisition Parameter
Instrument : JCM-6000PLUS
Acc. Voltage : 15.0 kV
Probe Current: 1.00000 nA
PHA mode : T3
Real Time : 50.97 sec
Live Time : 50.00 sec
Dead Time : 1 %
Counting Rate: 4126 cps
Energy Range : 0 - 20 keV

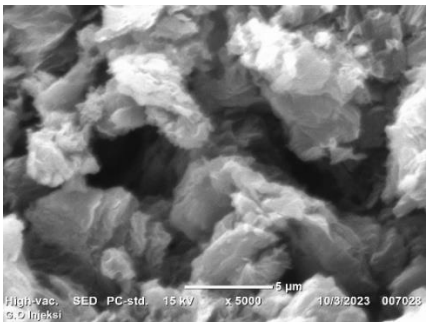
Thin Film Standardless Standardless Quantitative Analysis(Oxide)
Fitting Coefficient : 0.5454
Total Oxide : 24.0

Element	(keV)	Mass%	Counts	Sigma	Mol%	Compound	Mass%	Cation	K
C K (Ref.)	0.277	100.00	6031.17	0.84	100.00	C	100.00	0.00	1.0000
O		0.00				ND			
Total		100.00			100.00		100.00	0.00	

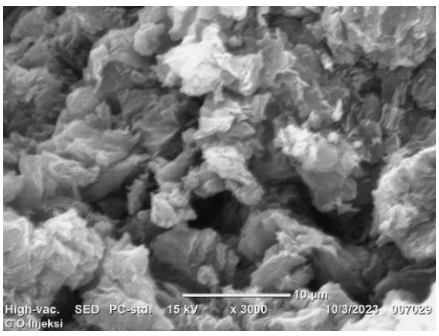
4.3. *Grafena Oksida* (GO) Injeksi



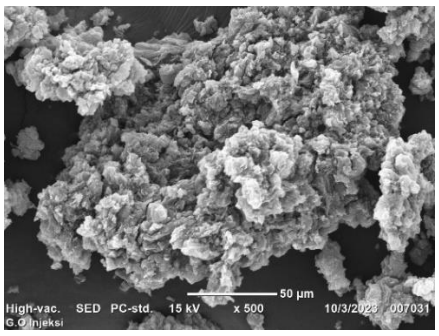
Perbesaran 10.000x



Perbesaran 5.000x

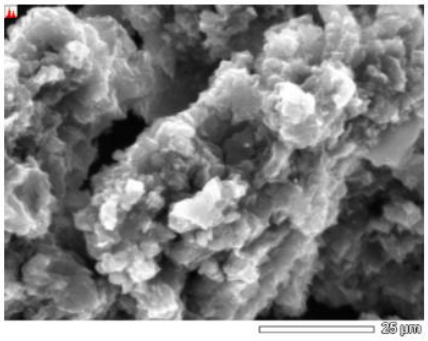


Perbesaran 3.000x



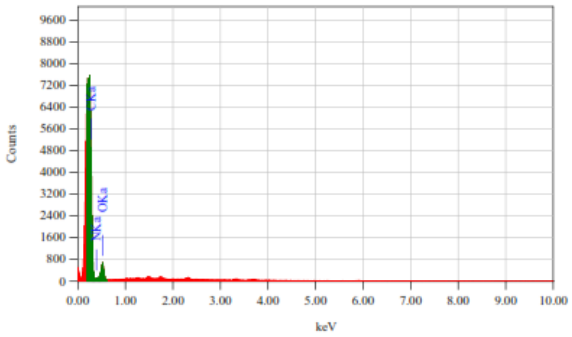
Perbesaran 500x

View000



JEOL 1/1

Title : IMG1
Instrument : JCM-6000PLUS
Volt : 15.00 kV
Mag. : x 1,300
Date : 2023/10/02
Pixel : 512 x 384



Acquisition Parameter
Instrument : JCM-6000PLUS
Acc. Voltage : 15.0 kV
Probe Current: 1.00000 nA
PHA mode : T3
Real Time : 50.86 sec
Live Time : 50.00 sec
Dead Time : 1 %
Counting Rate: 2957 cps
Energy Range : 0 - 20 keV

Thin Film Standardless Standardless Quantitative Analysis(Oxide)
Fitting Coefficient : 0.8026
Total Oxide : 24.0

Element	(keV)	Mass%	Counts	Sigma	Mol%	Compound	Mass%	Cation	K
C K (Ref.)	0.277	99.76	11113.18	0.59	99.80	C	99.76	0.00	1.0000
N K*	0.392	0.24	47.23	0.07	0.20	N	0.24	0.00	0.5549
O		0.00					ND		
Total		100.00			100.00		100.00	0.00	

Lampiran 5. Analisis Data

5.1. Perhitungan nilai *d-spacing*

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

$$n\,\lambda = 2\,d\,sin\theta$$

atau

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

Ket :

λ = 1.5406 Á

θ = Posisi puncak (dalam Radian)

n = 1 (prde fraksi)

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

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

2θ = 24,44°

θ = $\frac{24,44}{2}$ = 12,2200

d = $\frac{1x1,5406}{2\sin(12,2200)}$

d = 3,63 Á

2θ = 44,07°

θ = $\frac{44,07}{2}$ = 22,0350

d = $\frac{1x1,5406}{2\sin(22,0350)}$

d = 2,05 Á

b. Jarak antar lapisan (*d-spacing*) pada GO non-injeksi

2θ = 23,24°

θ = $\frac{23,24}{2}$ = 11,6200

d = $\frac{1x1,5406}{2\sin(11,6200)}$

d = 3,82 Á

2θ = 44,28°

θ = $\frac{44,28}{2}$ = 22,1400

d = $\frac{1x1,5406}{2\sin(22,1400)}$

d = 2,04 Å

c. Jarak antar lapisan (*d-spacing*) pada GO injeksi gas nitrogen

2θ = 25,12^o

θ = $\frac{25,12}{2}$ = 12,5600

d = $\frac{1x1,5406}{2\sin(12,5600)}$

d = 3,54 Å

2θ = 44,28^o

θ = $\frac{44,28}{2}$ = 22,1400

d = $\frac{1x1,5406}{2\sin(22,1400)}$

d = 2,04 Å

5.2. Perhitungan nilai kapasitansi spesifik

Perhitungan nilai kapasitansi spesifik (Cs) dapat menggunakan persamaan sebagai berikut:

$$\mathbf{Cs} = \frac{\boldsymbol{Q}}{\boldsymbol{V}}$$

atau

$$\mathbf{Cs} = \frac{\boldsymbol{A}}{\mathbf{2}\,\boldsymbol{mk}\,(\boldsymbol{V2}-\boldsymbol{V1})} \qquad \mathbf{(1)}$$

Ket:

Cs = Kapasitansi Spesifik (F/g)

A = Luas Area

m = Massa elektroda (g)

k = Scan Rate (mV/s)

ΔV = Potensial Window (V)

a. Nilai kapasitansi spesifik pada GO non-injeks

k = 50 mV/s

A = 30,3411

ΔV = V_2-V_1 = 0,9 V-(-0,1 V) = 1 V

m = 1 g

Cs = $\frac{30,3411}{2x1x50(1)}$ = 0,3034 F/g

b. Nilai kapasitansi spesifik pada GO injeks gas nitrogen

k = 50 mV/s

A = 44,7601

ΔV = V_2-V_1 = 0,9 V-(-0,1 V) = 1 V

m = 1 g

Cs = $\frac{44,7601}{2x1x50(1)}$ = 0,4476 F/g

5.3 Perhitungan nilai energi spesifik

Perhitungan nilai energi spesifik (Es) dapat menggunakan persamaan sebagai berikut:

$$E_s = \frac{Cs\ (\Delta V)2}{(4x3,6)}$$

$$E_s = \frac{1}{2} C_s(\Delta V)^2 \qquad (1)$$

Ket:

Es = Energi Spesifik (Wh/kg)

Cs = Kapasitansi Spesifik (F/g)

ΔV = Potensial Window (V)

a. Nilai energi spesifik pada GO non-injeks

Cs = 0,3034 F/g

ΔV = V_2-V_1 = 0,9 V-(-0,1 V) = 1 V

Es = $\frac{1}{2}$ x 0,3034 x 1 = 0,1517 Wh/kg

b. Nilai energi spesifik pada GO injeks gas nitrogen

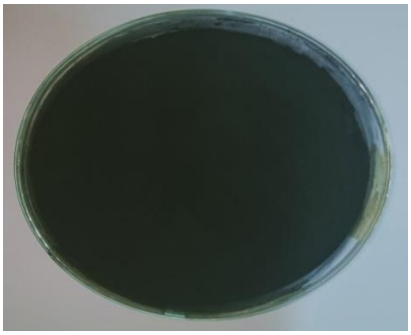
Cs = 0,4476 F/g

ΔV = V_2-V_1 = 0,9 V-(-0,1 V) = 1 V

Es = $\frac{1}{2}$ x 0,4476 x 1 = 0,2238 Wh/kg

Lampiran 6 Dokumentasi Kegiatan Penelitian

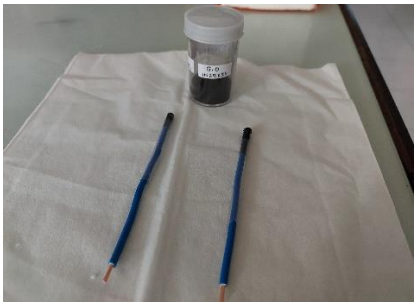
Sampel Limbah Tempurung Kelapa



Karbon Tempurung Kelapa

Ice Bath Oksida Karbon

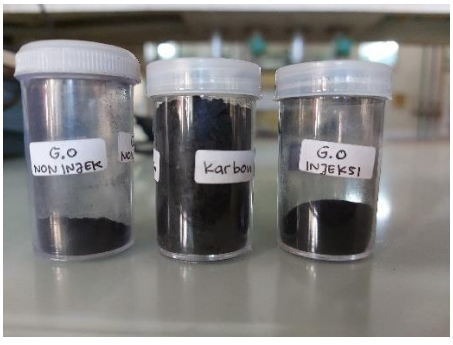
Suspensi Hijau



Elektroda GO Injeksi

Elektroda GO Non Injeksi

Proses Injeksi



GO, Karbon dan GO Injeksi