

DAFTAR PUSTAKA

- [1] P. O. Ukaogo, U. Ewuzie, and C. V. Onwuka, *Environmental pollution: Causes, effects, and the remedies*. INC, 2020. doi: 10.1016/B978-0-12-819001-2.00021-8.
- [2] J. Lin, Z. Luo, J. Liu, and P. Li, “Photocatalytic degradation of methylene blue in aqueous solution by using ZnO-SnO₂ nanocomposites,” *Mater Sci Semicond Process*, vol. 87, no. 20, pp. 24–31, 2018, doi: 10.1016/j.mssp.2018.07.003.
- [3] M. R. Islam, M. Rahman, S. F. U. Farhad, and J. Podder, “Structural , optical and photocatalysis properties of sol – gel deposited Al- doped ZnO thin fi lms,” *Surfaces and Interfaces*, vol. 16, no. February, pp. 120–126, 2019, doi: 10.1016/j.surfin.2019.05.007.
- [4] I. Ahmad, M. S. Akhtar, E. Ahmed, and M. Ahmad, “Highly efficient visible light driven photocatalytic activity of graphene and CNTs based Mg doped ZnO photocatalysts: A comparative study,” *Sep Purif Technol*, vol. 245, no. March, p. 116892, 2020, doi: 10.1016/j.seppur.2020.116892.
- [5] T. B. Ivetic et al., “Effect of annealing temperature on structural and optical properties of Mg-doped ZnO nanoparticles and their photocatalytic efficiency in alprazolam degradation,” *Ceram Int*, vol. 40, no. 1 PART B, pp. 1545–1552, 2014, doi: 10.1016/j.ceramint.2013.07.041.
- [6] M. Kamaraj, N. R. Srinivasan, G. Assefa, A. T. Adugna, and M. Kebede, “Facile development of sunlit ZnO nanoparticles-activated carbon hybrid from pernicious weed as an operative nano-adsorbent for removal of methylene blue and chromium from aqueous solution: Extended application in tannery industrial wastewater,” *Environ Technol Innov*, vol. 17, 2020, doi: 10.1016/j.eti.2019.100540.
- [7] K. Anil, I. Vinod, and S. Shrivastava, “Photocatalytic degradation of methylene blue using ZnO and 2 % Fe – ZnO semiconductor nanomaterials synthesized by sol – gel method : a comparative study,” *SN Appl Sci*, no. September, 2019, doi: 10.1007/s42452-019-1279-5.
- [8] A. K. Azfar, M. F. Kasim, I. M. Lokman, H. A. Rafaie, and M. S. Mastuli, “Comparative study on photocatalytic activity of transition metals (Ag and Ni) - doped ZnO nanomaterials synthesized via sol – gel method,” 2020.
- [9] J. Garvasis, A. R. Prasad, K. O. Shamshera, P. K. Jaseela, and A. Joseph, “Efficient removal of Congo red from aqueous solutions using phytogenic aluminum sulfate nano coagulant,” *Mater Chem Phys*, vol. 251, p. 123040, 2020, doi: 10.1016/j.matchemphys.2020.123040.
- [10] M. Náfrádi, T. Alapi, B. Veres, L. Farkas, G. Bencsik, and C. Janáky, “Comparison of TiO₂ and ZnO for Heterogeneous Photocatalytic Activation of the Peroxydisulfate Ion in Trimethoprim Degradation,” *Materials*, vol. 16, no. 17, 2023, doi: 10.3390/ma16175920.

- [11] Y. Xue, Q. Chang, X. Hu, J. Cai, and H. Yang, “A simple strategy for selective photocatalysis degradation of organic dyes through selective adsorption enrichment by using a complex film of CdS and carboxylmethyl starch,” *J Environ Manage*, vol. 274, no. 51778279, p. 111184, 2020, doi: 10.1016/j.jenvman.2020.111184.
- [12] A. Moulahi, “Efficient photocatalytic performance of Mg doping ZnO for the photodegradation of the rhodamine B,” *Inorg Chem Commun*, vol. 133, no. September, p. 108906, 2021, doi: 10.1016/j.inoche.2021.108906.
- [13] A. Khatri, V. Jangra, and P. S. Rana, “Efficient photocatalytic degradation of rose Bengal dye by Cu doped zinc oxide nanoparticles,” *AIP Conf Proc*, vol. 2265, no. November, 2020, doi: 10.1063/5.0017150.
- [14] R. E. Adam, H. Alnoor, G. Pozina, X. Liu, M. Willander, and O. Nur, “Synthesis of Mg-doped ZnO NPs via a chemical low-temperature method and investigation of the efficient photocatalytic activity for the degradation of dyes under solar light,” *Solid State Sci*, 2019, doi: 10.1016/j.solidstatesciences.2019.106053.
- [15] R. Sagheer, M. Khalil, V. Abbas, Z. N. Kayani, U. Tariq, and F. Ashraf, “Effect of Mg doping on structural, morphological, optical and thermal properties of ZnO nanoparticles,” *Optik (Stuttg)*, vol. 200, no. September 2019, 2020, doi: 10.1016/j.ijleo.2019.163428.
- [16] Z. Quan *et al.*, “Robust room temperature ferromagnetism and band gap tuning in nonmagnetic Mg doped ZnO films,” *Appl Surf Sci*, vol. 399, pp. 751–757, 2017, doi: 10.1016/j.apsusc.2016.12.143.
- [17] H. Zhu *et al.*, “Temperature-triggered switchable superwettability on a robust paint for controllable photocatalysis,” *Cell Rep Phys Sci*, vol. 2, no. 12, p. 100669, 2021, doi: 10.1016/j.xcrp.2021.100669.
- [18] O. Długosz, N. Wąsowicz, K. Szostak, and M. Banach, “Photocatalytic properties of coating materials enriched with bentonite/ZnO/CuO nanocomposite,” *Mater Chem Phys*, vol. 260, p. 124150, 2021, doi: 10.1016/j.matchemphys.2020.124150.
- [19] A. K. Sarkar Phyllis, G. Tortora, and I. Johnson, “Photodegradation,” *The Fairchild Books Dictionary of Textiles*, 2022, doi: 10.5040/9781501365072.12105.
- [20] R. Elshypany *et al.*, “Elaboration of Fe₃O₄/ZnO nanocomposite with highly performance photocatalytic activity for degradation methylene blue under visible light irradiation,” *Environ Technol Innov*, vol. 23, p. 101710, 2021, doi: 10.1016/j.eti.2021.101710.
- [21] D. Bokov *et al.*, “Nanomaterial by Sol-Gel Method: Synthesis and Application,” *Advances in Materials Science and Engineering*, vol. 2021, 2021, doi: 10.1155/2021/5102014.

- [22] Y. Tao and P. P. Pescarmona, “Nanostructured Oxides Synthesised via Application in Catalysis,” no. Cvd, pp. 1–28, 2018, doi: 10.3390/catal8050212.
- [23] C. Suryanarayana, “Mechanical Alloying: A Novel Technique to Synthesize Advanced Materials,” *Research*, vol. 2019, no. May, 2019, doi: 10.34133/2019/4219812.
- [24] J. A. Smeltzer *et al.*, “Optimization of cryogenic mechanical alloying parameters to synthesize ultrahard refractory high entropy materials,” *Mater Des*, vol. 210, p. 110070, 2021, doi: 10.1016/j.matdes.2021.110070.
- [25] V. Aghaali, T. Ebadzadeh, and Z. Karimi, “Effect of mechanical alloying and preheating treatment on the phase transformation of the Al e Cu e Fe compacts annealed by microwave radiation,” *Journal of Materials Research and Technology*, vol. 12, pp. 749–759, 2020, doi: 10.1016/j.jmrt.2021.02.089.
- [26] Y. A. B. Neolaka *et al.*, “Indonesian Kesambi wood (*Schleichera oleosa*) activated with pyrolysis and H₂SO₄ combination methods to produce mesoporous activated carbon for Pb(II) adsorption from aqueous solution,” *Environ Technol Innov*, vol. 24, p. 101997, 2021, doi: 10.1016/j.eti.2021.101997.
- [27] A. Machrouhi, H. Khar, A. Elhalil, M. Sadiq, M. Abdennouri, and N. Barka, “Synthesis, characterization, and photocatalytic degradation of anionic dyes using a novel ZnO/activated carbon composite,” *Watershed Ecology and the Environment*, vol. 5, pp. 80–87, 2023, doi: 10.1016/j.wsee.2022.12.001.
- [28] J. Hammouche, K. Daoudi, S. Columbus, R. Ziad, K. Ramachandran, and M. Gaidi, “Structural and morphological optimization of Ni doped ZnO decorated silicon nanowires for photocatalytic degradation of methylene blue,” *Inorg Chem Commun*, vol. 131, no. June, p. 108763, 2021, doi: 10.1016/j.inoche.2021.108763.
- [29] P. Šimonová, W. Pabst, and J. Cibulková, “Crystallite size of pure tin oxide ceramics and its growth during sintering determined from XRD line broadening – A methodological case study and a practitioners’ guide,” *Ceram Int*, vol. 47, no. 24, pp. 35333–35347, 2021, doi: 10.1016/j.ceramint.2021.09.076.
- [30] R. R. and V. K. Vinodkumar Etacheri, “Mg-Doped ZnO Nanoparticles for Efficient Mg-Doped ZnO Nanoparticles for Efficient Sunlight-Driven,” *Spectrochim Acta A Mol Biomol Spectrosc*, vol. 130, pp. 581–590, 2014.
- [31] S. Rafique, A. K. Kasi, J. K. Kasi, Aminullah, M. Bokhari, and Z. Shakoor, “Fabrication of silver-doped zinc oxide nanorods piezoelectric nanogenerator on cotton fabric to utilize and optimize the charging system,” *Nanomaterials and Nanotechnology*, vol. 10, pp. 1–12, 2020, doi: 10.1177/1847980419895741.

- [32] D. Shao and Q. Wei, “Microwave-assisted rapid preparation of nano-ZnO/Ag composite functionalized polyester nonwoven membrane for improving its UV shielding and antibacterial properties,” *Materials*, vol. 11, no. 8, 2018, doi: 10.3390/ma11081412.
- [33] M. A. Bhatti *et al.*, “Enzymes and phytochemicals from neem extract robustly tuned the photocatalytic activity of ZnO for the degradation of malachite green (MG) in aqueous media,” *Research on Chemical Intermediates*, vol. 47, no. 4, pp. 1581–1599, 2021, doi: 10.1007/s11164-020-04391-6.
- [34] O. Hafez, Z. J. Othman, M. Megdich, and A. Matoussi, “Conduction mechanism and dielectric properties of ZnO/MgO solid composites,” *Appl Phys A Mater Sci Process*, vol. 123, no. 1, pp. 1–11, 2017, doi: 10.1007/s00339-016-0721-4.
- [35] A. Cyril, G. Senthamilselvan, A. Palanimurugan, and A. Dhanalakshmi, “ZnO AND ALKALINE EARTH METAL (Mg) DOPED ZnO NANOPARTICLES FOR ANTIBACTERIAL ACTIVITY, STRUCTURAL AND THERMAL STUDIES,” *J Adv Sci Res*, vol. 13, no. 03, pp. 190–193, 2022, doi: 10.55218/jasr.202213329.
- [36] K. R. Yoon *et al.*, “Surface-initiated, ring-opening polymerization of p-dioxanone from gold and silicon oxide surfaces,” *J Mater Chem*, vol. 13, no. 12, pp. 2910–2914, 2003, doi: 10.1039/b305903k.
- [37] R. E. Adam, H. Alnoor, G. Pozina, X. Liu, M. Willander, and O. Nur, “Synthesis of Mg-doped ZnO NPs via a chemical low-temperature method and investigation of the efficient photocatalytic activity for the degradation of dyes under solar light,” *Solid State Sci*, vol. 99, 2020, doi: 10.1016/j.solidstatesciences.2019.106053.
- [38] O. A. Zelekew, P. Asefa, F. K. Sabir, and A. D. Duma, “*Eichhornia Crassipes* Plant Extract Tempered Green Synthesis of Cr₂O₃/ZnO Composite Catalyst for the Degradation of Organic Dye,” *SSRN Electronic Journal*, no. May, 2021, doi: 10.2139/ssrn.3807243.
- [39] N. Shadan, A. A. Ziabari, R. Meraat, and K. M. Jalali, “The effects of Mg incorporation and annealing temperature on the physicochemical properties and antibacterial activity against Listeria monocytogenes of ZnO nanoparticles,” *Pramana - Journal of Physics*, vol. 88, no. 2, 2017, doi: 10.1007/s12043-016-1341-4.
- [40] I. Choudhary, R. Shukla, A. Sharma, and K. K. Raina, “Effect of excitation wavelength and europium doping on the optical properties of nanoscale zinc oxide,” *Journal of Materials Science: Materials in Electronics*, vol. 31, no. 22, pp. 20033–20042, 2020, doi: 10.1007/s10854-020-04525-x.
- [41] P. Makuła, M. Pacia, and W. Macyk, “How To Correctly Determine the Band Gap Energy of Modified Semiconductor Photocatalysts Based on UV-

- Vis Spectra," *Journal of Physical Chemistry Letters*, vol. 9, no. 23, pp. 6814–6817, 2018, doi: 10.1021/acs.jpclett.8b02892.
- [42] V. S. Bystrov *et al.*, "Oxygen vacancies, the optical band gap (E_g) and photocatalysis of hydroxyapatite: Comparing modelling with measured data," *Appl Catal B*, vol. 196, pp. 100–107, Nov. 2016, doi: 10.1016/j.apcatb.2016.05.014.
- [43] Y. Shen, L. Lei, X. Zhang, M. Zhou, and Y. Zhang, "Effect of various gases and chemical catalysts on phenol degradation pathways by pulsed electrical discharges," *J Hazard Mater*, vol. 150, no. 3, pp. 713–722, Feb. 2008, doi: 10.1016/j.jhazmat.2007.05.024.
- [44] Mw. Aminullah, H. Setiawan, A. Huda, H. Samaulah, S. Haryati, and Md. Bustan, "Pengaruh Komposisi Material Semikonduktor Dalam Menurunkan Energi Band Gap dan Terhadap Konversi Gelombang Mikro," *Jurnal EECCIS*, vol. 13, no. 2, pp. 65–70, 2019.
- [45] S. Gea *et al.*, "Facile synthesis of ZnO–Ag nanocomposite supported by graphene oxide with stabilised band-gap and wider visible-light region for photocatalyst application," *Journal of Materials Research and Technology*, vol. 19, pp. 2730–2741, 2022, doi: 10.1016/j.jmrt.2022.05.184.
- [46] A. Balcha, O. P. Yadav, and T. Dey, "Photocatalytic degradation of methylene blue dye by zinc oxide nanoparticles obtained from precipitation and sol-gel methods," *Environmental Science and Pollution Research*, vol. 23, no. 24, pp. 25485–25493, 2016, doi: 10.1007/s11356-016-7750-6.
- [47] X. Chen, Z. Wu, D. Liu, and Z. Gao, "Preparation of ZnO Photocatalyst for the Efficient and Rapid Photocatalytic Degradation of Azo Dyes," *Nanoscale Res Lett*, vol. 12, no. 1, pp. 4–13, 2017, doi: 10.1186/s11671-017-1904-4.
- [48] I. Ahmad, "Comparative study of metal (Al, Mg, Ni, Cu and Ag) doped ZnO/g-C₃N₄ composites: Efficient photocatalysts for the degradation of organic pollutants," *Sep Purif Technol*, vol. 251, no. July, 2020, doi: 10.1016/j.seppur.2020.117372.
- [49] J. T. Adeleke, T. Theivasanthi, M. Thiruppatti, M. Swaminathan, T. Akomolafe, and A. B. Alabi, "Photocatalytic degradation of methylene blue by ZnO/NiFe₂O₄ nanoparticles," *Appl Surf Sci*, vol. 455, pp. 195–200, 2018, doi: 10.1016/j.apsusc.2018.05.184.
- [50] J. Podder, "Structural, optical and photocatalysis properties of sol–gel deposited Aldoped ZnO," *Surfaces and Interfaces*, 2019, doi: 10.1016/j.surfin.2019.05.007.
- [51] L. V. Trandafilović, D. J. Jovanović, X. Zhang, S. Ptasińska, and M. D. Dramićanin, "Enhanced photocatalytic degradation of methylene blue and methyl orange by ZnO:Eu nanoparticles," *Appl Catal B*, vol. 203, pp. 740–752, 2017, doi: 10.1016/j.apcatb.2016.10.063.

LAMPIRAN

Lampiran 1. Analisis Data

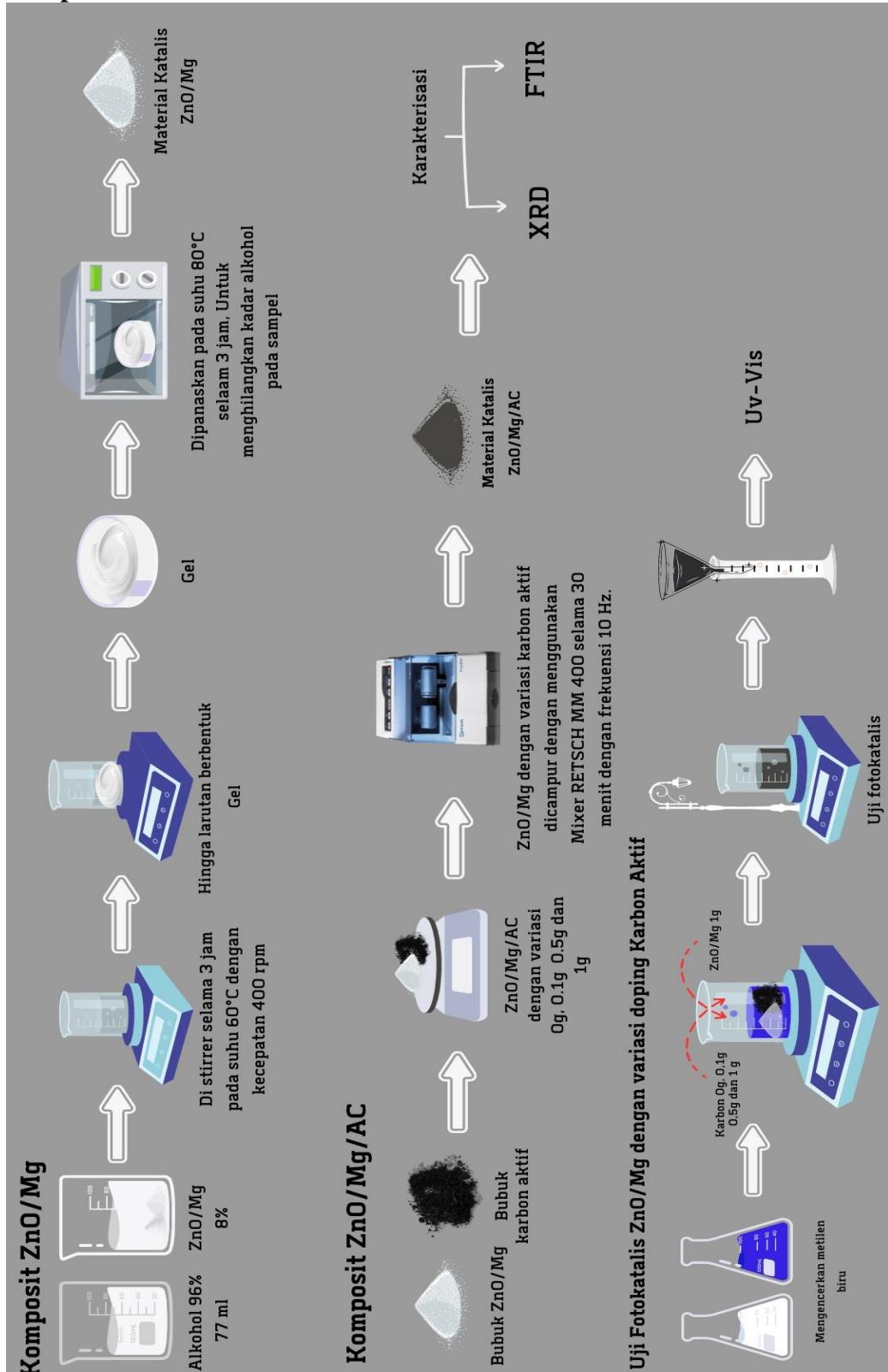
Tabel 1. Analisis Data XRD untuk Ukuran Rata-Rata Kristal Komposit ZnO/Mg/Karbon Aktif

Variasi doping	2θ	FWHM	Rata-rata ukuran kristal
1 gr	50.5394	0.39803	22.6784251
0.5 gr	47.9594	0.27857	31.94975673
0.1 gr	50.6554	0.27085	33.04562599
0 gr	50.668	0.23621	37.78578862

Tabel 2. Analisis Data Uv-vis untuk presentase degradasi komposit ZnO/Mg/Karbon Aktif

%Degradation	ZnO/Mg/Karbon	%Degradation	
		C1 (Ct=10 menit)	C2=(Ct=15 menit)
0 gr	78.995	84.525	
0.1 gr	80.515	85.625	
0.5 gr	80.515	85.66	
1 gr	80.31	87.695	

Lampiran 2. Prosedur Percobaan



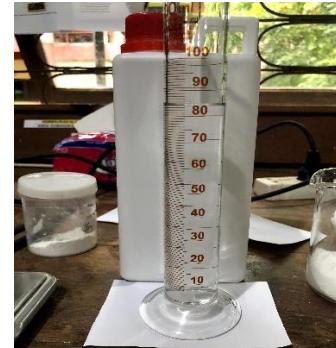
Lampiran 3. Dokumentasi Penelitian
Preparasi ZnO/Mg



ZnO



Mg



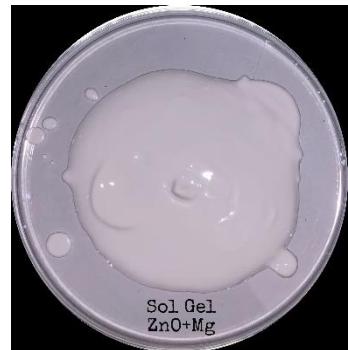
Alkohol



ZnO di campurkan
Mg dengan Alkohol



Di stirer selama 3 jam
dengan suhu 80°C



Larutan berbentuk Gel



Dipanaskan pada suhu 80°C
Selama 3 jam untuk menghilangkan
Kadar alkohol pada sampel

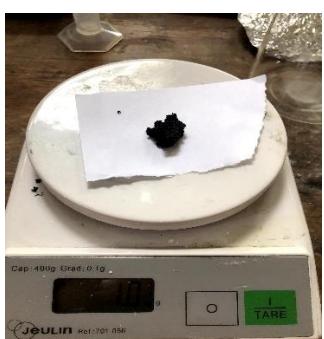


Bubuk
ZnO/Mg

Preparasi Uji Fotokatalis



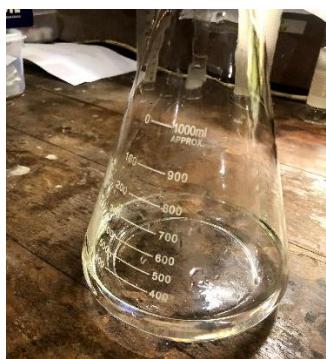
ZnO/Mg



Karbon (0gr, 0,1gr,
0,5 gr dan 1 gr)



MAHASISWA PENELITIA
MB (0,25 ml)



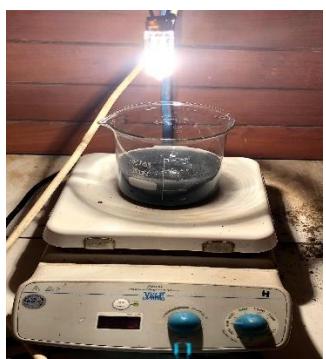
Akuades 250 ml



Akuades dan MB



Di stirer selama
10 dan 15 menit
Tanpa karbon

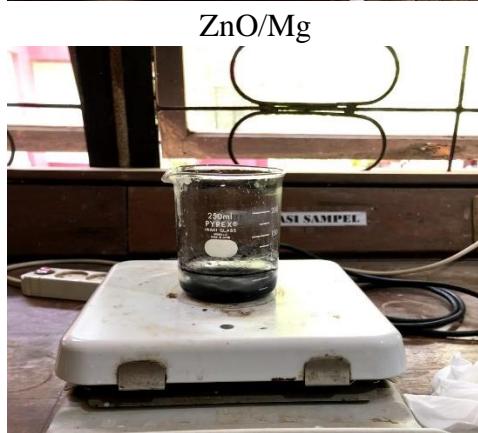


Di stirer selama 10 dan
15 menit dengan karbon
0,1 gr, 0,5 gr dan 1 gr

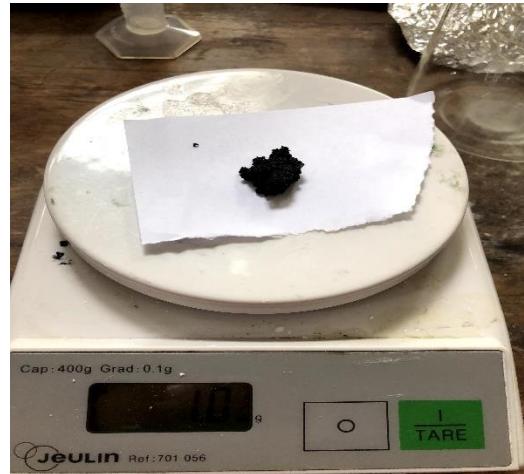


Di saring

Preparasi uji BandGap



Di stirer selama 10 menit



Karbon (0gr, 0,1gr, 0,5 gr dan 1 gr)



Di saring dengan kertas
whatmann no 42