

DAFTAR PUSTAKA

- [1] Dragana, Š., Christos, A.A., Goran Š, Marinos, D., Mladenka, N., Tamara, I., & Spyros, N.Y. (2018). Photocatalytic degradation of naproxen and methylene blue: Comparison between ZnO, TiO₂ and their mixture. *Process Safety and Environmental Protection*, 113, 174-183. <https://doi.org/10.1016/j.psep.2017.10.007>
- [2] Jiaojiao, L., Zhazhou, L., Jiaojiao, L., & Ping Li. (2018). Photocatalytic degradation of methylene blue in aqueous solution by using ZnO-SnO₂ nanocomposites. *Materials Science in Semiconductor Processing*, 87(15), 24-31. <https://doi.org/10.1016/j.mssp.2018.07.003>
- [3] Kalpesh, A.I., & Vinod S.S. (2019). Photocatalytic degradation of methylene blue using ZnO and 2%Fe-ZnO semiconductor nanomaterials synthesized by sol-gel method: a comparative study. 1, 1247. <https://doi.org/10.1007/s42452-019-1279-5>
- [4] Daria, S., Sindu, S., Oleksandr, P., Sviatlana, L., Martina B., Mikhail, Z., Franz, F., Rainer, A., Yogendra, K.M. (2019). Mutual interplay of ZnO micro-and nanowires and methylene blue during cyclic photocatalysis process. *Journal of Environmental Chemical Engineering*, 7(2), 103016. <https://doi.org/10.1016/j.jece.2019.103016>
- [5] Nandini, R., & Santanu, C. (2020). ZnO as photocatalyst: An approach to waste water treatment. *Materials Today: Proceedings*, 46(14), 6399-6403. <https://doi.org/10.1016/j.matpr.2020.06.264>
- [6] Naciri, Y., A, Hsini., Z. Ajmal, A. Bouddouch, B. Bakiz, J.A. Navío, A. Albourine, J-C. Valmalette, M. Ezahri, & A. Benlhachemi. (2020). Influence of Sr-doping on structural, optical and photocatalytic properties of synthesized Ca₃(PO₄)₂. *Journal of Colloid and Interface Science*, 572, 269-280. <https://doi.org/10.1016/j.jcis.2020.03.105>
- [7] Pujiastuti, C., Y Ngatilah., M Septianto., & A Tantyono. (2020). Reaction Kinetics The Formation of Calcium Sulfate From Cow Bone And Sulfuric Acid In Batch. *Journal of Physics: Conference Series*, 1569, 042053. <https://doi.org/10.1088/1742-6596/1569/4/042053>
- [8] Azfar, A.K., Kasim, M.F., Lokman, I.M., Rafaie, H.A., & Mastuli, M.S. (2021). Comparative study on photocatalytic activity of transition metals (Ag and Ni)-

doped ZnO nanomaterials synthesized via sol–gel method. 7(2),191590.
<http://dx.doi.org/10.1098/rsos.191590>

- [9] Xiaoqing, C., Zhansheng, W., Dandan, L., & Zhenzhen, G. (2017). Preparation of ZnO Photocatalyst for the Efficient and Rapid Photocatalytic Degradation of Azo Dyes. *J Mater Sci: Mater Electron*, 12(1), 143. <https://doi.org/10.1007/s10854-015-2680-5>
- [10] Yuxiang Xue, Qianqian Chang, Xinyu Hu, Jun Cai, dan Hu Yang. (2020). A simple strategy for selective photocatalysis degradation of organic dyes through selective adsorption enrichment by using a complex film of CdS and carboxymethyl starch. *Journal of Environmental Management*. 274, 1 11184.
- [11] Abarna Krishna Moorthy, Bhuvanewari Govindarajan Rathi, Satya Prakash Shukla , Kundan Kumar dan Vidya Shree Bharti. (2021). Acute toxicity of textile dye Methylene blue on growth and metabolism of selected freshwater microalgae. *Environmental Toxicology and Pharmacology*. 82, 103552. <https://doi.org/10.1016/j.etap.2020.103552>
- [12] Himanshu Patel dan R.T.Vashi. (2015). Characterization and Treatment of Textile Wastewater. Elsevier. Chapter 3, 73-110 <https://doi.org/10.1016/C2014-0-02395-7>
- [13] Dong Xu dan Hailing Ma. (2021). Degradation of rhodamine B in water by ultrasound-assisted TiO₂ photocatalysis. *Journal of Cleaner Production*. 313, 127758. <https://doi.org/10.1016/j.jclepro.2021.127758>
- [14] Muhammad R. I, Mukhlasur. R, S.F.U. Farhadb dan J. Poddera. Structural, optical and photocatalysis properties of sol–gel deposited Aldoped ZnO thin films. Vol.16; 120-126 (2019). <https://doi.org/10.1016/j.surfin.2019.05.007>
- [15] Chun HongVoon dan Sung TingSam. (2019). Nanobiosensors for Biomolecular Targeting. Elsevier. Chapter 2, 23-50 <https://doi.org/10.1016/C2017-0-00809-1>
- [16] Elim Albiter, José M.Barrera-Andrade, Elizabeth Rojas-García dan Miguel A.Valenzuela. (2019). Nanocarbon and its Composites: Preparation, Properties and Applications. Elsevier. Chapter 17, 521-588. <https://doi.org/10.1016/B978-0-08-102509-3.00017-1>

- [17] Sudtha Murthy, Paul Effiong dan Chee Chin Fei. (2020). Metal Oxide Powder Technologies: *Fundamentals, Processing Methods and Applications*. Elsevier. Chapter 11, 233-251. <https://doi.org/10.1016/B978-0-12-817505-7.00011-7>
- [18] Ü. Özgür, Ya. I. Alivov, C. Liu, A. Teke, M. A. Reshchikov, S. Doğan, V. Avrutin, S.-J. Cho, dan H. Morkoç. (2005). A comprehensive review of ZnO materials and devices. *Journal Of Applied Physics*, 98, 041301. <http://dx.doi.org/10.1063/1.1992666>
- [19] T.A.van Vugt, J.A.P.Geurts, J.J.Arts, dan N.C.Lindfors. Management of Periprosthetic Joint Infections (PJIs). Elsevier. Chapter 3, 41-68. <https://doi.org/10.1016/B978-0-08-100205-6.00003-3>
- [20] Inna V. Fadeeva, Bogdan I. Lazoryak, Galina A. Davidova, Fadis F. Murzakhanov, Bulat F. Gabbasov, Natalya V. Petrakova, Marco Fosca, Sergey M. Barinov, Gianluca Vadal`a, Vuk Uskokovi, Yufeng Zheng, dan Julietta V. Rau. (2021). Antibacterial and cell-friendly copper-substituted tricalcium phosphate ceramics for biomedical implant applications. *Materials Science & Engineering C*. 129, 112410. <https://doi.org/10.1016/j.msec.2021.112410>
- [21] M.R.Cohn, A.Unnanuntana, T.J.Pannu, S.J.Warner, dan J.M.Lane. (2017). *Comprehensive Biomaterials II*. Elsevier. Chapter 7, 278-297. <https://doi.org/10.1016/B978-0-12-803581-8.10109-2>
- [22] Sudha Prasad, Vijayalakshmi Kumar, Sangeetha Kirubanandam, dan Ahmed Barhoum. (2018). Emerging Applications of Nanoparticles and Architecture Nanostructures Current Prospects and Future Trends. Elsevier. Chapter 11, 305-340. <https://doi.org/10.1016/B978-0-323-51254-1.00011-7>
- [23] Ionela Andreea Neacșu, Adrian Ionuț Nicoară, Otilia Ruxandra Vasile, dan Bogdan Ștefan Vasile. (2016). *Nanobiomaterials in Hard Tissue Engineering*. Elsevier. Chapter 9. <https://doi.org/10.1016/B978-0-323-42862-0.00009-2>
- [24] Massimiliano D'Arienzo, Roberto Scotti, Barbara Di Credico, Matteo Redaelli. (2017). *Studies in Surface Science and Catalysis*. Elsevier. Chapter 13. 477-540. <https://doi.org/10.1016/B978-0-12-805090-3.00013-9>
- [25] Yanet Rodriguez Herrero dan Aman Ullah. (2020). Metal Oxide Powder Technologies *Fundamentals, Processing Methods and Applications*. Elsevier. Chapter 14. 279-297. <https://doi.org/10.1016/B978-0-12-817505-7.00014-2>

- [26] Elhalil, A., Elmoubarki, R., Farnane, M., Machrouhi, A., Mahjoubi, F.Z., Sadiq, M., Qourzal, S., & Barka, N. (2018). Synthesis, characterization and efficient photocatalytic activity of novel Ca/ZnO-Al₂O₃ nanomaterial. *Materialstoday communications*, 16, 194-203. <https://doi.org/10.1016/j.mtcomm.2018.06.005>
- [27] Azhar A.K., & J, Yan, C.Y.Z. (2021). Investigating the effects of ZnO dopant on the thermodynamic and kinetic properties of CaCO₃/CaO TCES system. *Energy*. 215, 119132. <https://doi.org/10.1016/j.energy.2020.119132>
- [28] Nguyen, T.H., Nguyen L.M.T., Doan, V.T., Mai, H.T.T., Thanh-Dong, P., Tran, D.M., Hoang, T.T., Mai T.B., Minh V.N. (2019). Monocrotophos pesticide effectively removed by novel visible light driven Cu doped ZnO photocatalyst. *Journal of Photochemistry and Photobiology A: Chemistry*, 382, 111923. <https://doi.org/10.1016/j.jphotochem.2019.111923>
- [29] Bahrul, U., Sultan, I., Ahmad, N.F., Inayatul, M., Muhammad, A.A., Nurfina, Y., Eymal, B., Demmalino & Dahlang, T. (2020). Composite carbon-lignin/ zinc oxide nanocrystalline ball-like hexagonal mediated from *Jatropha curcas* L leaf as photocatalyst for industrial dye degradation. *Journal of Inorganic and Organometallic Polymers and Materials*, 30(12), 4905-4916. <https://doi.org/10.1007/s10904-020-01631-5>
- [30] Rico, N., Dwi, N.H., Dwi, G.A., Is, F. (2020). Pengolahan Limbah Batik Cair Menggunakan Fotokatalis TiO₂-Abu Vulkanik Desa Wukirsari Yogyakarta, 10(2), 1-8. <https://journal.uui.ac.id/khazanah/article/view/16647>
- [31] Noah, A.Z., Semary, M.A.E., Youssef, A.M., & El-Safty, M.A. (2017). Enhancement of yield point at high pressure high temperature wells by using polymer nanocomposites based on ZnO & CaCO₃ nanoparticles. *Egyptian Journal of Petroleum*, 26, 33-40. <http://dx.doi.org/10.1016/j.ejpe.2016.03.002>
- [32] Selvaraj, P., Kalimuthu, A., Manjunathan, N., Palaniswamy, K., Kathirvel, D., Rajamani, R., & V. Bhuvaneshwari., Devaraj, B. (2020). Synthesis and characterization of chitosan/zinc oxide nanocomposite for antibacterial activity onto cotton fabrics and dye degradation applications. *International Journal of Biological Macromolecules*, 164, 2779-2787. <https://doi.org/10.1016/j.ijbiomac.2020.08.047>
- [33] Anabel, D.A., Patricia, R.T., Patricia, M., Piedad, N.D.A. (2020). In vitro characterization of new biphasic scaffolds in the sub-system Ca₃(PO₄)₂-Ca₅SiP₂O₁₂.

Ceramics International, 46(11), 18123-18130.
<https://doi.org/10.1016/j.ceramint.2020.04.133>

- [34] Maria, M.F.F., Ikhmal, W.M.K.W.M., Amirah, M.N.N.S., Manja, S.M. Syaizwadi, S.M., Chan, K.S., Sabri, M.G.M., & Adnan, A. (2019). Green approach in anti-corrosion coating by using *Andrographis paniculata* leaves extract as additives of stainless steel 316L in seawater. *Journal of Corrosion and Scale Inhibition*, 8(3), 644-658. <https://doi.org/10.17675/2305-6894-2019-8-3-13>
- [35] Alessandra, D., Johannes, K., Massimo, L., Emanuela, C., Stefania, M., Paolo, G., Altero, A., Loretta, G., Silvia, L., & Luisa, M. (2018). Qualitative Analysis of Traditional Italian Dishes:FTIR Approach. *Sustainability*, 10, 4112. <https://doi.org/10.3390/su10114112>
- [36] Hend, A.E., & Ahmed, M.I. Effective Fabrication and Characterization of Eco-friendly Nano Chitosan Capped Zinc Oxide Nanoparticles for Effective Marine Fouling Inhibition. *Journal of Environmental Chemical Engineering*, 8(4), 103949. <https://doi.org/10.1016/j.jece.2020.103949>
- [37] Muhammad, R.I., Mukhlasur, R,S.F.U., Farhadb & J, Poddera. (2019). Structural, optical and photocatalysis properties of sol-gel deposited Aldoped ZnO thin films. *Journal of Inorganic and Organometallic Polymers and Materials*, 16, 120-126. <https://doi.org/10.1016/j.surfin.2019.05.007>
- [38] Choudhary, I., Shukla, R., Sharma, A., Raina, K. (2020). Effect of excitation wavelength and europium doping on the optical properties of nanoscale zinc oxide, *Journal of Materials Science: Materials in Electronics*, 31, 20033-20042. <https://doi.org/10.1007/s10854-020-04525-x>
- [39] Naik, E.I., Naik, H.S.B., Swamy, B.E.K., Viswanath, R., Gowda, I.K.S., Prabhakara, M.C., & Chetankumar, K. (2021). Influence of Cu doping on ZnO nanoparticles for improved structural, optical, electrochemical properties and their applications in efficient detection of latent fingerprints. *Chemical Data Collections*, 33, 100671 <https://doi.org/10.1016/j.cdc.2021.100671>
- [40] Adeleke, J.T., Theivasanthi, T., Thiruppathi, M., Swaminathan, M., Akomolafe, T., & Alabi, A.B.. (2018). Photocatalytic degradation of methylene blue by ZnO/NiFe₂O₄ nanoparticles. *Applied Surface Science*, 455, 195-200. <https://doi.org/10.1016/j.apsusc.2018.05.184>

- [41] Sonal, S., Saurabh, D & Shukla, A.K. (2018). Self-assembly of the Ag deposited ZnO/carbon nanospheres: A resourceful photocatalyst for efficient photocatalytic degradation of methylene blue dye in water. *Advanced Powder Technology*, 12 (29), 3483-3492. <https://doi.org/10.1016/j.appt.2018.09.031>
- [42] Saravanan, S., Mohana, M.K., Navaneethan, M., Ponnusamy, S., & Muthamizchelvan, C. (2019). Synthesis and photocatalytic activity of Gd doped ZnO nanoparticles for enhanced degradation of methylene blue under visible light. *Materials Science in Semiconductor Processing*, 103, 104622. <https://doi.org/10.1016/j.mssp.2019.104622>
- [43] Selvi, N., Sankar, S., & Dinakaran, K. (2015). Effect of shell ZnO on the structure and optical property of TiO₂ core@shell hybrid nanoparticles, *J. Mater. Sci: Mater. Electron.* 26, 2271-2277. <https://doi.org/10.1007/s10854-015-2680-5>
- [44] Trandafilović, V., Jovanović, D.J., Zhang, X., Ptasińska, S., & Dramićanin, M.D. (2017). Enhanced photocatalytic degradation of methylene blue and methylorange by ZnO:Eu nanoparticles. *Applied Catalysis B: Environmental*, 17, 740-752. <http://dx.doi.org/10.1016/j.apcatb.2016.10.063>

Lampiran 1

1. 4 jam

No	2Theta	theta	Theta (rad)	Cos(Theta)	FWHM	FWHM (Rad)	D (nm)
1	31.7533	15.877	0.277099817	0.961852877	0.3381	0.00590096	24.42874837
2	32.24	16.12	0.281347075	0.960682295	0.1772	0.00309272	46.66717709
3	34.4084	17.204	0.300269935	0.95256683	0.3335	0.00582067	24.93670757
4	34.82	17.41	0.303861823	0.954188122	0.2514	0.00438776	33.1173636
5	36.2363	18.118	0.316221372	0.950417269	0.3336	0.00582242	25.05616929
6	36.72	18.36	0.320442451	0.949096145	0.1476	0.00257611	56.70984607
7	47.521	23.761	0.414698957	0.915237657	0.3508	0.00612262	28.74352502
8	56.5763	28.288	0.493721357	0.880575386	0.3222	0.00562345	28.00031759
9	57	28.5	0.497418837	0.878817113	0.1528	0.00266686	59.16068257
10	62.832	31.416	0.548312638	0.853405271	0.3335	0.00582067	27.91283037
11	63.22	31.61	0.551698577	0.851635468	0.148	0.00288789	63.0288785
12	66.3589	33.179	0.579090647	0.836960651	0.3112	0.00543146	30.50074212
13	67.9201	33.96	0.592714687	0.829427273	0.3391	0.00591841	28.24547833
14	68.34	34.17	0.596379005	0.827374767	0.1734	0.0030264	55.37371618
15	69.0528	34.526	0.602599359	0.82386512	0.3191	0.0056935	30.21844516
16	72.5533	36.277	0.633146984	0.806169481	0.2667	0.00465479	36.94925332

rata-rata 30.02800753

2. 120 menit

No	2Theta	theta	Theta (rad)	Cos(Theta)	FWHM	FWHM (Rad)	D (nm)
1	31.7377	15.869	0.276963681	0.961890111	0.2877	0.00502131	28.70712588
2	34.3881	17.194	0.300092784	0.955309065	0.2698	0.00470789	30.82259438
3	36.218	18.109	0.316061674	0.950466919	0.271	0.00472984	30.84244072
4	47.4988	23.749	0.414505225	0.915315697	0.2437	0.00425337	35.61464306
5	56.5554	28.278	0.493538897	0.880661806	0.242	0.0042237	37.276710341
6	56.84	28.42	0.496022573	0.879482495	0.1028	0.0017942	60.0017942
7	62.8144	31.407	0.548159049	0.853485319	0.2432	0.00424464	38.27325596
8	66.3357	33.168	0.578888188	0.837071432	0.218	0.00380482	43.53474664
9	67.9005	33.95	0.592543644	0.829522808	0.2405	0.00419752	39.82095059
10	69.0377	34.519	0.602467587	0.823939799	0.2326	0.00405964	41.45241558
11							
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16							

rata-rata 36.26047514

3. 90 menit

No	2Theta	theta	Theta (rad)	Cos(Theta)	FWHM	FWHM (Rad)	D (nm)
1	32.1482	16.074	0.280545969	0.960904413	0.4493	0.00784176	18.40087303
2	34.7821	17.391	0.303531083	0.954287029	0.4443	0.0077545	18.73698466
3	36.6071	18.304	0.319457212	0.949406021	0.4473	0.00780686	18.7070004
4	47.8532	23.927	0.417597949	0.914065767	0.439	0.007662	19.79762396
5	56.9079	28.454	0.496615113	0.879200333	0.4126	0.00720123	21.89969003
6	63.1599	31.578	0.551147925	0.851923955	0.3938	0.00687311	23.67982527
7	66.8785	33.339	0.581879683	0.835431062	0.3971	0.0069307	23.94663694
8	68.2443	34.122	0.595543865	0.827843535	0.3913	0.00682947	24.52431727
9	69.3768	34.688	0.605426792	0.822259279	0.375	0.00654498	25.76410048
10	72.86	36.43	0.635823447	0.804582974	0.36	0.00628319	27.4272141
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12							
13							
14							
15							
16							

rata-rata 21.71745023

No	2Theta	theta	Theta (rad)	Cos(Theta)	FWHM	FWHM (Rad)	D (nm)
1	32.2082	16.104	0.281069568	0.960759307	0.3057	0.00533547	27.04861275
2	34.861	17.431	0.304219615	0.954081006	0.2915	0.00508763	28.56480254
3	36.6889	18.344	0.320171052	0.949181997	0.3016	0.00526391	27.75072852
4	47.9586	23.979	0.418517737	0.913692345	0.2944	0.00513825	29.53365813
5	56.9954	28.498	0.497378694	0.878836266	0.3034	0.00529633	29.79418352
6	63.2414	31.621	0.551885327	0.851337571	0.3068	0.00535467	30.40856077
7	66.7528	33.376	0.582528072	0.835074534	0.2943	0.0051365	32.32507441
8	67.98	33.99	0.593237413	0.829135158	0.19	0.00331613	
9	68.3201	34.16	0.596205345	0.827472291	0.2989	0.00521679	32.12000917
10	69.4466	34.723	0.606035912	0.821912469	0.3067	0.00535292	31.51488237
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15							
16							

rata-rata 29.89561246

5. Suhu Ruang

No	2Theta	theta	Theta (rad)	Cos(Theta)	FWHM	FWHM (Rad)	D (nm)
1	32.166	16.083	0.280701304	0.960861393	0.364	0.006353	22.71396268
2	34.8178	17.409	0.303842624	0.954193866	0.3535	0.00616974	23.55206531
3	36.6484	18.324	0.319817623	0.949292772	0.3561	0.00621512	23.50081304
4	47.9268	23.963	0.41824023	0.913805091	0.3517	0.00613832	24.71889734
5	56.9762	28.488	0.497211143	0.878916197	0.3156	0.00550826	28.63983905
6	63.2293	31.615	0.551779734	0.851592928	0.3205	0.00559378	29.10683308
7	66.7293	33.365	0.582322986	0.835187337	0.3159	0.0055135	30.11074554
8	68.3068	34.153	0.596088281	0.827537456	0.2994	0.00522552	32.06384344
9	69.446	34.723	0.606030676	0.821915451	0.3009	0.0052517	32.12223113
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rata-rata 27.39213674