

DAFTAR PUSTAKA

- 'Aliaa, R.N., Othman, S.A., 2023. *Characterization of Doped Titanium Dioxide (TiO₂) at Different Calcination Temperature Using X-Ray Diffraction (XRD)*. ASM Sci. J. 18. <https://doi.org/10.32802/ASMSCJ.2023.983>.
- Abd Mutalib, M., Rahman, M.A., Othman, M.H.D., Ismail, A.F., Jaafar, J., 2017. *Scanning Electron Microscopy (SEM) and Energy-Dispersive X-Ray (EDX) Spectroscopy, Membrane Characterization*. Elsevier B.V. <https://doi.org/10.1016/B978-0-444-63776-5.00009-7>.
- Abdullah, M., 2008. *Pengantar Nanosains*. Institut Teknologi Bandung, Bandung.
- Abisharani, J.M., Devikala, S., Dinesh Kumar, R., Arthanareeswari, M., Kamaraj, P., 2019. *Green synthesis of TiO₂ nanoparticles using Cucurbita pepo seeds extract*. Mater. Today Proc. 14, 302–307. <https://doi.org/10.1016/j.matpr.2019.04.151>.
- Adrianto, N., Panre, A.M., Istiqomah, N.I., Riswan, M., Apriliani, F., Suharyadi, E., 2022. *Localized surface plasmon resonance properties of green synthesized silver nanoparticles*. Nano-Structures & Nano-Objects 31, 100895. <https://doi.org/10.1016/j.nanoso.2022.100895>.
- Ahmad, W., Jaiswal, K.K., Soni, S., 2020. *Green synthesis of titanium dioxide (TiO₂) nanoparticles by using Mentha arvensis leaves extract and its antimicrobial properties*. Inorg. Nano-Metal Chem. 50, 1032–1038. <https://doi.org/10.1080/24701556.2020.1732419>.
- Aisida, S., Ugwu, K., Akpa, P.A., Nwanya, A.C., Nwankwo, U., Bashir, A.K.H., G, M.I., Ahmed, I., Ezema, F.I., 2020. *Synthesis and characterization of iron oxide nanoparticles capped with Moringa Oleifera: The mechanisms of formation effects on the optical, structural, magnetic and morphological properties*. Mater. Today Proceedings. Elsevier Ltd.
- Akhtar, M.S., Panwar, J., Yun, Y.S., 2013. *Biogenic synthesis of metallic nanoparticles by plant extracts*. ACS Sustain. Chem. Eng. 1, 591–602. <https://doi.org/10.1021/sc300118u>.
- Alam, J., Bran, C., Chiriac, H., Lupu, N., Óvári, T.A., Panina, L. V., Rodionova, V., Varga, R., Vazquez, M., Zhukov, A., 2020. *Cylindrical micro and nanowires: Fabrication, properties and applications*. J. Magn. Mater. 513, 167074. <https://doi.org/10.1016/j.jmmm.2020.167074>.
- Alinsafi, A., Evenou, F., Abdulkarim, E.M., Pons, M.N., Zahraa, O., Benhammou, A., Yaacoubi, A., Nejmeddine, A., 2007. *Treatment of textile industry wastewater by*

<https://doi.org/10.1016/j.dyepig.2006.02.024>.

Altaf, S., Zafar, R., Zaman, W.Q., Ahmad, S., Yaqoob, K., Syed, A., Khan, A.J., Bilal, M., Arshad, M., 2021. *Removal of levofloxacin from aqueous solution by green synthesized magnetite (Fe₃O₄) nanoparticles using Moringa olifera: Kinetics and reaction mechanism analysis.* *Ecotoxicol. Environ. Saf.* 226, 112826.

<https://doi.org/10.1016/j.ecoenv.2021.112826>.

Anandan, S., Selvamani, T., Prasad, G.G., M. Asiri, A., J. Wu, J., 2017. *Magnetic and catalytic properties of inverse spinel CuFe₂O₄ nanoparticles.* *J. Magn. Magn. Mater.* 432, 437–443. <https://doi.org/10.1016/j.jmmm.2017.02.026>.

Aracely, H.-R., Iliana, M.-R., 2014. *Photocatalytic Semiconductors Synthesis, Characterization, and Environmental Application.* Springer International Publishing, Heidelberg.

Ardakani, S.S.Y., Abghari, R., Mirjalili, M., 2019. *TiO₂@CoFe₂O₄ nanofiber for the photocatalytic degradation of Direct Red 80.* *Phys. Chem. Res.* 7, 309–325. <https://doi.org/10.22036/pcr.2019.158459.1567>.

Ates, B., Koytepe, S., Ulu, A., Gurses, C., Thakur, V.K., 2020. *Chemistry, structures, and advanced applications of nanocomposites from biorenewable resources.* *Chem. Rev.* 120, 9304–9362. <https://doi.org/10.1021/acs.chemrev.9b00553>.

Atla, S.B., Wun-Rong, L., Ting-Che, C., Min-Jen, T., Jwu-Ching, S., ChienCheng, C., Chien-Yen, C., 2018. *Fabrication of Fe₃O₄/ZnO Magnetite Core Shell and Its Application in Photocatalysis Using Sunlight.* *Mater. Chem. Phys.* 216, 380–86.

applications. *Results Mater.* 19, 100431. <https://doi.org/10.1016/j.rinma.2023.100431>

Becker, A., Kirchberg, K., Marschall, R., 2020. *Magnesium ferrite (MgFe₂O₄) nanoparticles for photocatalytic antibiotics Degradation.* *Zeitschrift fur Phys. Chemie* 234, 645–654. <https://doi.org/10.1515/zpch-2019-1430>.

Bindhu, M.R., Umadevi, M., Esmail, G.A., Al-Dhabi, N.A., Arasu, M. V., 2020. *Journal of Photochemistry & Photobiology , B : Biology Green synthesis and characterization of silver nanoparticles from Moringa oleifera flower and assessment of antimicrobial and sensing properties.* *J. Photochem. Photobiol. B Biol. Elsevier* 111836.

Chang Chien, S.W., Ng, D.Q., Kumar, D., Lam, S.M., Jaffari, Z.H., 2022. *Investigating the effects of various synthesis routes on morphological, optical, photoelectrochemical and photocatalytic properties of single-phase perovskite BiFeO₃.* *J. Phys. Chem. Solids* 160, 110342. <https://doi.org/10.1016/j.jpcs.2021.110342>.

Chang, L., Pu, Y., Jing, P., Cui, Y., Zhang, G., Xu, S., Cao, B., Guo, J., Chen, F., Qiao, C.,

2021. *Magnetic core-shell MnFe₂O₄@TiO₂ nanoparticles decorated on reduced graphene oxide as a novel adsorbent for the removal of ciprofloxacin and Cu(II) from water*. Appl. Surf. Sci. 541, 148400. <https://doi.org/10.1016/j.apsusc.2020.148400>.
- Chen, D., Cheng, Y., Zhou, N., Chen, P., Wang, Y., Li, K., Huo, S., Cheng, P., Peng, P., Zhang, R., Wang, L., Liu, H., Liu, Y., Ruan, R., 2020. *Photocatalytic degradation of organic pollutants using TiO₂-based photocatalysts: A review*. J. Clean. Prod. 268, 121725. <https://doi.org/10.1016/j.jclepro.2020.121725>.
- Chen, G., Xu, Y., Wu, J., Li, N., Guo, M., 2021. *Anti-Inflammatory Properties and Potential Bioactive Components from Moringa oleifera Leaves Revealed by Affinity Ultrafiltration LC-MS and Molecular Docking*. ACS Food Sci. Technol. 1, 1953–1962. <https://doi.org/10.1021/acsfoodscitech.1c00275>.
- Chen, L., Batjikh, I., Hurh, J., Han, Y., Huo, Y., Ali, H., Li, J.F., Rupa, E.J., Ahn, J.C., Mathiyalagan, R., Yang, D.C., 2019. *Green synthesis of zinc oxide nanoparticles from root extract of Scutellaria baicalensis and its photocatalytic degradation activity using methylene blue*. Optik (Stuttg). 184, 324–329. <https://doi.org/10.1016/j.ijleo.2019.03.051>.
- Cheng, B., Liu, X., Hu, J., 2022. *Fe₃O₄ thin films epitaxially growth model on TiO₂-terminated SrTiO₃(100)*. Micro and Nanostructures 167. <https://doi.org/10.1016/j.spmi.2022.107183>.
- Choudhury, B., Choudhury, A., 2012. *Dopant induced changes in structural and optical properties of Cr³⁺ doped TiO₂ nanoparticles*. Mater. Chem. Phys. 132, 1112–1118. <https://doi.org/10.1016/j.matchemphys.2011.12.083>.
- Coey, J.M., 2009. Magnetism and Magnetic Materials, 1st ed. Cambridge University Press, Cambridge.
- Cuana, R., Panre, A.M., Istiqomah, N.I., Tumbelaka, R.M., Sunaryono, Wicaksono, S.T., Suharyadi, E., 2022. *Green Synthesis of Fe₃O₄/Chitosan Nanoparticles Utilizing Moringa Oleifera Extracts and Their Surface Plasmon Resonance Properties*. ECS J. Solid State Sci. Technol. 11, 083015. <https://doi.org/10.1149/2162-8777/ac8b36>.
- Derakhshani, E., Naghizadeh, A., Mortazavi-Derazkola, S., 2023. *Biosynthesis of MnFe₂O₄@TiO₂ magnetic nanocomposite using oleaster tree bark for efficient photocatalytic degradation of humic acid in aqueous solutions*. Environ. Sci. Pollut. Res. 30, 3862–3871. <https://doi.org/10.1007/s11356-022-22518-7>.
- Fahey, J., 2005. *Moringa oleifera: A Review of The Medical Evidence for Its Nutritional, Therapeutic, and Prophylactic Properties. Part 1*. Trees life J. 1, 1–15.
- Fajaroh, F., 2018. *Sintesis Nanopartikel dengan Prinsip Kimia Hijau*. Semin. Nas. Kim. dan Pembelajarannya 2018 03, 24–32.

- Fakhari, S., Jamzad, M., Kabiri Fard, H., 2019. *Green synthesis of zinc oxide nanoparticles: a comparison.* Green Chem. Lett. Rev. 12, 19–24. <https://doi.org/10.1080/17518253.2018.1547925>.
- Fatimah, I., Aftrid, Z.H.V.I., 2019. *Characteristics and antibacterial activity of green synthesized silver nanoparticles using red spinach (Amaranthus Tricolor L.) leaf extract.* Green Chem. Lett. Rev. 12, 25–30. <https://doi.org/10.1080/17518253.2019.1569729>.
- Fatimah, I., Sugiharto, E., Wijaya, K., Tahir, I., Kamalia, K., 2010. *Titanium Oxide Dispersed on Natural Zeolite (TiO₂/Zeolite) and Its Application for Congo Red Photodegradation.* Indo. J. Chem 6, 38–42.
- Ferdosi, E., H., B., D., G., 2019. *Investigation the photocatalytic activity of CoFe₂O₄/ZnO and CoFe₂O₄/ZnO/Ag nanocomposites for purification of dye pollutants.* Sep. Purif. Technol. 211, 35–39.
- Foner, S., 1985. *Versatile and Sensitive Vibrating-Sample Magnetometer.* Rev. Sci Instrum 30, 557.
- Gandhi, N., 2009. *Incorporation of Nano Particles of Cobalt Ferrite into Conjugated Polymer Matrix for EMI Shielding Applications.* Thapar University.
- Gangwar, A., Varghese, S.S., sharma, A., Meena, S.S., Prajapat, C.L., Viswanadh, M.K., Neogi, K., Muthu, M.S., Prasad, N.K., 2020. *Physical and in-vitro evaluation of ε-Fe₃N@Fe₃O₄ nanoparticles for bioapplications.* Ceram. Int. 46, 10952–10962. <https://doi.org/10.1016/j.ceramint.2020.01.110>.
- Ghanbarnezhad, S., Baghshahi, S., Nemati, A., Mahmoodi, M., 2017. *Preparation, magnetic properties, and photocatalytic performance under natural daylight irradiation of Fe₃O₄-ZnO core/shell nanoparticles designed on reduced GO platelet.* Mater. Sci. Semicond. Process. 72, 85–92. <https://doi.org/10.1016/j.mssp.2017.09.015>.
- Gholami, T., Bazarganipour, M., Salavati-Niasari, M., Bagheri, S., 2015. *Photocatalytic degradation of methylene blue on TiO₂@SiO₂ core/shell nanoparticles: synthesis and characterization.* J. Mater. Sci. Mater. Electron. 26, 6170–6177. <https://doi.org/10.1007/s10854-015-3198-6>.
- Ghosh, P.R., Fawcett, D., Sharma, S.B., Poinern, G.E.J., 2017. *Production of high-value nanoparticles via biogenic processes using aquacultural and horticultural food waste.* Materials (Basel). 10. <https://doi.org/10.3390/ma10080852>.
- Gingasu, D., Mindru, I., Preda, S., Calderon-Moreno, J.M., Culi, D.C., Patron, L., Diamandescu, L., 2017. *Green synthesis of cobalt ferrite nanoparticles using plant extracts.* Rev. Roum. Chim. 62, 645–653.

- Gnanasekaran, L., Hemamalini, R., Rajendran, S., Qin, J., Yola, M.L., Atar, N., Gracia, F., 2019. *Nanosized Fe₃O₄ incorporated on a TiO₂ surface for the enhanced photocatalytic degradation of organic pollutants*. J. Mol. Liq. 287, 110967. <https://doi.org/10.1016/j.molliq.2019.110967>.
- Gupta, S.M., Tripathi, M., 2011. *A review of TiO₂ nanoparticles*. Chinese Sci. Bull. 56, 1639–1657. <https://doi.org/10.1007/s11434-011-4476-1>.
- Hadiyawardman, Rijal, A., Nuryadin, B.W., Abdullah, M., Khairurrijal, 2008. *Fabrikasi Material Nanokomposit Superkuat, Ringan dan Transparan Menggunakan Metode Simple Mixing*. J. Nanosains Nanoteknologi 1, 14–21.
- Harraz, F.A., Mohamed, R.M., Rashad, M.M., Wang, Y.C., Sigmund, W., 2014. *Magnetic nanocomposite based on titania-silica/cobalt ferrite for photocatalytic degradation of methylene blue dye*. Ceram. Int. 40, 375–384. <https://doi.org/10.1016/j.ceramint.2013.06.012>.
- He, Z., Fareed, H., Yang, H., Xia, Y., Su, J., Wang, L., Kang, L., Wu, M., Huang, Z., 2023. *Mechanistic insight into the charge carrier separation and molecular oxygen activation of manganese doping BiOBr hollow microspheres*. J. Colloid Interface Sci. 629, 355–367. <https://doi.org/10.1016/j.jcis.2022.08.164>.
- He, Z., Siddique, M.S., Yang, H., Xia, Y., Su, J., Tang, B., Wang, L., Kang, L., Huang, Z., 2022. *Novel Z-scheme In₂S₃/Bi₂WO₆ core-shell heterojunctions with synergistic enhanced photocatalytic degradation of tetracycline hydrochloride*. J. Clean. Prod. 339, 130634. <https://doi.org/10.1016/j.jclepro.2022.130634>.
- He, Z., Yang, H., Su, J., Xia, Y., Fu, X., Wang, L., Kang, L., 2021. *Construction of multifunctional dual Z-scheme composites with enhanced photocatalytic activities for degradation of ciprofloxacin*. Fuel 294, 120399. <https://doi.org/10.1016/j.fuel.2021.120399>.
- Hosseinpour-Mashkani, S.M., Maddahfar, M., Sobhani-Nasab, A., 2016. *Precipitation Synthesis, Characterization, Morphological Control, and Photocatalyst Application of ZnWO₄ Nanoparticles*. J. Electron. Mater. 45, 3612–3620. <https://doi.org/10.1007/s11664-016-4532-3>.
- Houshiar, M., Zebhi, F., Razi, Z.J., Alidoust, A., Askari, Z., 2014. *Synthesis of cobalt ferrite (CoFe₂O₄) nanoparticles using combustion, coprecipitation, and precipitation methods: A comparison study of size, structural, and magnetic properties*. J. Magn. Mater. 371, 43–48. <https://doi.org/10.1016/j.jmmm.2014.06.059>.
- Im, J.S., Kim M. Il, Lee. Y.S, 2008. *Preparation of PAN-based electrospun nanofiber webs*

- Jayan, N., Laxmi Deepak Bhatlu, M., Akbar, S.T., 2021. *Central Composite Design for Adsorption of Pb(II) and Zn(II) Metals on PKM-2 Moringa oleifera Leaves*. ACS Omega 6, 25277–25298. <https://doi.org/10.1021/acsomega.1c03069>.
- Jesus, A.C.B., Jesus, J.R., Lima, R.J.S., Moura, K.O., Almeida, J.M.A., Duque, J.G.S., Meneses, C.T., 2020. *Synthesis and magnetic interaction on concentrated Fe₃O₄ nanoparticles obtained by the co-precipitation and hydrothermal chemical methods*. Ceram. Int. 46, 11149–11153. <https://doi.org/10.1016/j.ceramint.2020.01.135>.
- Jiang, X., Zhou, Q., Lian, Y., 2023. *Efficient Photocatalytic Degradation of Tetracycline on the MnFe₂O₄/BGA Composite under Visible Light*. Int. J. Mol. Sci. 24. <https://doi.org/10.3390/ijms24119378>.
- Jing, H., Hong-xia, J., Na, L., Long-xiang, L., Wei-zhou, J., 2019. *Fabrication of magnetically recyclable SnO₂-TiO₂/CoFe₂O₄ hollow core-shell photocatalyst: Improving photocatalytic efficiency under visible light irradiation*. J. Solid State Chem. 271, 103–109.
- Kadam, A., Bhopateb, D., Kondalkarc, V., Majhib, S., Bathulad, C., Trana, A., Lee, S., 2018. , *Facile Synthesis of Ag-ZnO Core-Shell Nanostructures with Enhanced Photocatalytic Activity*. J. Ind. Eng. Chem. 61, 78–86.
- Kadam, A.N., Bhopate, D.P., Kondalkar, V. V., Majhi, S.M., Bathula, C.D., Tran, A.V., Lee, S.W., 2018. *Facile synthesis of Ag-ZnO core-shell nanostructures with enhanced photocatalytic activity*. J. Ind. Eng. Chem. 61, 78–86. <https://doi.org/10.1016/j.jiec.2017.12.003>.
- Kalam, A., Al-Sehemi, A.G., Assiri, M., Du, G., Ahmad, T., Ahmad, I., Pannipara, M., 2018. *Modified Solvothermal Synthesis of Cobalt Ferrite (CoFe₂O₄) Magnetic Nanoparticles Photocatalysts for Degradation of Methylene Blue with H₂O₂/Visible Light*. Results Phys. 8 1046–1053.
- Kaur, H., Kaur, S., Singh, J., Rawat, M., Kumar, S., 2019. *Expanding horizon: Green synthesis of TiO₂ nanoparticles using Carica papaya leaves for photocatalysis application*. Mater. Res. Express 6, 1–10. <https://doi.org/10.1088/2053-1591/ab2ec5>.
- Kaushal, A., Kaur, D., 2009. *Effect of Mg content on structural, electrical and optical properties of Zn1-xMgxO nanocomposite thin films*. Sol. Energy Mater. Sol. Cells 93, 193–198. <https://doi.org/10.1016/j.solmat.2008.09.039>.
- Khalafalla, M.M., Abdellatef, E., Dafalla, H.M., Nassrallah, A.A., Aboul-Enein, K.M., Lightfoot, D.A., El-Deeb, F.E., El-Shemy, H.A., 2010. *Active principle from Moringa*

oleifera Lam leaves effective against two leukemias and a hepatocarcinoma. African J.

Biotechnol. 9, 8467–8471. <https://doi.org/10.4314/ajb.v9i49>.

Khashan, S., Dagher, S., Tit, N., Alazzam, A., Obaidat, I., 2017. *Novel method for synthesis of Fe₃O₄@TiO₂ core/shell nanoparticles*. Surf. Coatings Technol. 322, 92–98. <https://doi.org/10.1016/j.surfcoat.2017.05.045>.

Khatami, M., Alijani, H.Q., Nejad, M.S., Varma, R.S., 2018. *Core@shell nanoparticles: Greener synthesis using natural plant products*. Appl. Sci. 8, 1–17. <https://doi.org/10.3390/app8030411>.

Kianfar, A.H., Arayesh, M.A., 2020. *Synthesis, characterization and investigation of photocatalytic and catalytic applications of Fe₃O₄/TiO₂/CuO nanoparticles for degradation of MB and reduction of nitrophenols*. J. Environ. Chem. Eng. 8, 103640. <https://doi.org/10.1016/j.jece.2019.103640>.

Kumar, S., Kumar, Ajay, Kumar, Ashish, Krishnan, V., 2020. *Nanoscale zinc oxide based heterojunctions as visible light active photocatalysts for hydrogen energy and environmental remediation*. Catal. Rev. - Sci. Eng. 62, 346–405. <https://doi.org/10.1080/01614940.2019.1684649>.

Kushwaha, P., Chauhan, P., 2021. *Facile green synthesis of CoFe₂O₄ nanoparticles using hibiscus extract and their application in humidity sensing properties*. Inorg. Nano-Metal Chem. 0, 1–8. <https://doi.org/10.1080/24701556.2021.1992432>.

Larasati, D. A., Puspitarum, D. L., Darmawan, M. Y., Istiqomah, N. I., Partini, J., Aliah, H., Suharyadi, E., *Green synthesis of CoFe₂O₄/ZnS composite nanoparticles utilizing Moringa oleifera for magnetic hyperthermia applications*, Results Mater. 19 (2023) 100431. <https://doi.org/10.1016/j.rinma.2023.100431>.

Li, J., Yang, F., Zhou, Q., Wu, L., Li, W., Ren, R., Lv, Y., 2019. *Visible-light photocatalytic performance, recovery and degradation mechanism of ternary magnetic Fe₃O₄/BiOBr/BiOI composite*. RSC Adv. 9, 23545–23553. <https://doi.org/10.1039/c9ra04412d>.

Li, X., Xu, H., Wang, L., Zhang, L., Cao, X.F., Guo, Y.C., 2018. *Spinel NiFe₂O₄ nanoparticles decorated BiOBr nanosheets for improving the photocatalytic degradation of organic dye pollutants*. J. Taiwan Inst. Chem. Eng. 85, 257–264. <https://doi.org/10.1016/j.jtice.2018.01.043>.

Liu, L., He, W., Fang, Z., Yang, Z., Guo, K., Wang, Z., 2020. *From Core-Shell to Yolk-Shell: Improved Catalytic Performance toward CoFe₂O₄@Hollow@Mesoporous TiO₂ toward Selective Oxidation of Styrene*. Ind. Eng. Chem. Res. 59, 19938–19951.

- Loan, N.T.T., Nguyen, T.H.L., Nguyen, T.T.H., Nguen, Wu.H., Duong, T.T.A., Vu, T.H., Lam, V.T., Thuan, V.T., 2019. *CoFe₂O₄ Nanomaterials: Effect of Annealing Temperature on Characterization, Magnetic, Photocatalytic, and Photo-Fenton Properties*,. Processes 7, 1–14.
- Lone, I.H., Aslam, J., Radwan, N.R.E., Bashal, A.H., Ajlouni, A.F.A., Akhter, A., 2019. *Multiferroic ABO₃ Transition Metal Oxides: a Rare Interaction of Ferroelectricity and Magnetism*. Nanoscale Res. Lett. 14, 1–12. <https://doi.org/10.1186/s11671-019-2961-7>.
- Mabarroh N., Alfansuri, T., Wibowo, N.A., Istiqomah, N.I, Tumbelaka, R.M., Suharyadi, E., 2022. *Detection of green-synthesized magnetite nanoparticles using spin-valve GMR-based sensor and their potential as magnetic labels*. J. Magn. Mater. 560, 169645. <https://doi.org/10.1016/j.jmmm.2022.169645>.
- Mahdikah, V., Ataie, A., Babaei, A., Sheibani, S., Ow-Yang, C.W., Abkenar, S.K., 2020. *CoFe₂O₄/Fe magnetic nanocomposite: Exchange coupling behavior and microwave absorbing property*. Ceram. Int. 46, 17903–17916. <https://doi.org/10.1016/j.ceramint.2020.04.099>.
- Mandal, B., Panda, J., Paul, P.K., Sarkar, R., Tudu, B., 2020. *MnFe₂O₄ decorated reduced graphene oxide heterostructures: Nanophotocatalyst for methylene blue dye degradation*. Vacuum 173, 1–9. <https://doi.org/10.1016/j.vacuum.2019.109150>.
- Mateus, G.A.P., Paludo, M.P., Santos, T.R.T., Silva, M.F., Nishi, L., Fagundes-Klen, M.R., Gomes, R.G., Bermagasco, R., 2018. *Obtaining drinking water using a magnetic coagulant composed of magnetite nanoparticles functionalized with Moringa oleifera seed extract*. J. Environ. Chem. Eng. 6, 4084–4092.
- Mathew, D.S., Juang, R.S., 2007. *An overview of the structure and magnetism of spinel ferrite nanoparticles and their synthesis in microemulsions*. Chem. Eng. J. 129, 51–65. <https://doi.org/10.1016/j.cej.2006.11.001>.
- Mc Mahon, G., 2007. *A Guide to Laboratory, Portable and Miniaturized Instruments*. J. Wiley, England.
- Miclescu, A., Wiklund, L., 2014. *Methylene blue, an old drug with new indications*.
- Mohamad, M., Haq, B.U., Ahmed, R., Shaari, A., Ali, N., Hussain, R., 2015. *A density functional study of structural, electronic and optical properties of titanium dioxide: Characterization of rutile, anatase and brookite polymorphs*. Mater. Sci. Semicond. Process. 31, 405–414. <https://doi.org/10.1016/j.mssp.2014.12.027>.
- Moyo, B., Masika, P.J., Hugo, A., Muchenje, V., 2011. *Nutritional characterization of*

- Moringa (Moringa oleifera Lam.) leaves*. African J. Biotechnol. 10, 12925–12933. <https://doi.org/10.5897/ajb10.1599>.
- Mufti, N., Munfarriha, U., Fuad, A., Diantoro, M., 2016. *Synthesis and photocatalytic properties of Fe₃O₄@TiO₂ core-shell for degradation of Rhodamine B*. AIP Conf. Proc. 1712, 50009. <https://doi.org/10.1063/1.4941892>.
- Muzakki, A.T., 2020. *Sintesis, karakterisasi, dan uji aktivitas fotokatalitik dari nanopartikel Core-Shell CoFe₂O₄@ZnO*. Universitas Gadjah Mada.
- Ngom, I., Ngom, B.D., Sackey, J., Khamlich, S., 2019. *Biosynthesis of zinc oxide nanoparticles using extracts of Moringa Oleifera: Structural & optical properties*. Mater. Today Proc. 36, 526–533. <https://doi.org/10.1016/j.matpr.2020.05.323>
- Palanisamy, G., Bhuvaneswari, K., Bharathi, G., Pazhanivel, T., Grace, A.N., Pasha, S.K.K., 2021. *Construction of magnetically recoverable ZnS–WO₃–CoFe₂O₄ nanohybrid enriched photocatalyst for the degradation of MB dye under visible light irradiation*. Chemosphere 273, 129687. <https://doi.org/10.1016/j.chemosphere.2021.129687>.
- Pancotti, A., Santos, D.P., Morais, D.O., de Barros Souza, M.V., Lima, D.R., Scalla Vulcani, V.A., Martins, A., Landers, R., Braoios, A., 2021. *Synthesis, characterization and in vitro cytotoxicity study of Co and Ni ferrite nanoparticles prepared by sol-gel method*. SN Appl. Sci. 3. <https://doi.org/10.1007/s42452-021-04709-y>.
- Pavia, D., Lampman, G., Kriz, G., Vyvyan, J., 2009. *Introduction to Spectroscopy*, Lampman, G.M. Western Washington University, Washington.
- Phuong Vuong, 2018. *Optical spectroscopy of boron nitride heterostructures*. HAL Arch. - Ouvert.
- Polte, J., 2015. *Fundamental growth principles of colloidal metal nanoparticles - a new perspective*. CrystEngComm 17, 6809–6830. <https://doi.org/10.1039/c5ce01014d>.
- Prasad, C., Sreenivasulu, K., Gangadhara, S., Venkateswarlu, P., 2017. *Bio inspired green synthesis of Ni/Fe₃O₄ magnetic nanoparticles using Moringa oleifera leaves extract: A magnetically recoverable catalyst for organic dye degradation in aqueous solution*. J. Alloys Compd. 700, 252–258. <https://doi.org/10.1016/j.jallcom.2016.12.363>.
- Prasad, T.N.V.K.V., Elumalai, E.K., 2011. *Biofabrication of Ag nanoparticles using Moringa oleifera leaf extract and their antimicrobial activity*. Asian Pac. J. Trop. Biomed. 1, 439–442. [https://doi.org/10.1016/S2221-1691\(11\)60096-8](https://doi.org/10.1016/S2221-1691(11)60096-8).
- Prasankumar, R.P., Antoinette, J.T., 2011. *Optical Techniques for SolidState Materials Characterization*. CRC Press.
- Puspitarum, D.L., Istiqomah, N.I., Larasati, D.A., Kusumaatmaja, A., Aliah, H., Suharyadi, E.,

2023. *Photocatalytic mechanism and properties of recyclable hybrid magnetic/semiconductor nanocomposites synthesized via green route for organic dye degradation*. Results Mater. 19, 100439. <https://doi.org/10.1016/j.rinma.2023.100439>.
- Puspitarum, D.L., Istiqomah, N.I., Tumbelaka, R.M., Kusumaatmaja, A., Oshima, D., Kato, T., Suharyadi, E., 2022. *High performance of magnetically separable and recyclable photocatalyst of green- synthesized CoFe₂O₄/TiO₂ nanocomposites for degradation of methylene blue*. Adv. Nat. Sci. Nanosci. Nanotechnol. 13, 45003. <https://doi.org/10.1088/2043-6262/ac996b>.
- Qu, X., Alvarez, P.J., Li, Q., 2013. *Applications of nanotechnology in water and wastewater treatment*. Water Res. 47, 3931–3946.
- Rani, B.J., Ravina, M., Saravanakumar, B., Ravi, G., Ganesh, V., Ravichandran, S., Yuvakkumar, R., 2018. *Ferrimagnetism in cobalt ferrite (CoFe₂O₄) nanoparticles*. Nano-Structures and Nano-Objects 14, 84–91. <https://doi.org/10.1016/j.nanoso.2018.01.012>.
- Rani, M., Keshu, Shanker, U., 2021. *Efficient degradation of organic pollutants by novel titanium dioxide coupled bismuth oxide nanocomposite: Green synthesis, kinetics and photoactivity*. J. Environ. Manage. 300, 113777. <https://doi.org/10.1016/j.jenvman.2021.113777>.
- Rani, N.Z., Husain, K., Kumolosasi, E., 2018. *Moringa genus: A review of phytochemistry and pharmacology*. Front. Pharmacol. 1–26.
- Rao, K.G., Ashok, C., Rao, K.V., Shilpa Chakra, C., Rajendar, V., 2015a. *Synthesis of TiO₂ Nanoparticles From Orange Fruit Waste*. Int. J. Multidiscip. Adv. Res. Trends 2, 82–90.
- Rao, K.G., Ashok, C., Rao, K. V, Chakra, C.S., Tambur, P., 2015b. *Green Synthesis of TiO₂ Nanoparticles Using Aloe Vera Extract*. Int. J. Av. Res. Phys. Sci. 2, 28–34.
- Reddy, D.H.K., Ramana, D.K.V., Seshaiyah, K., Reddy, A.V.R., 2011. *Biosorption of Ni(II) from aqueous phase by Moringa oleifera bark, a low cost biosorbent*. Desalination 268, 150–157. <https://doi.org/10.1016/j.desal.2010.10.011>.
- Salamat, S., Younesi, H., Bahramifar, N., 2017. *Synthesis of magnetic core-shell Fe₃O₄@TiO₂ nanoparticles from electric arc furnace dust for photocatalytic degradation of steel mill wastewater*. RSC Adv. 7, 19391–19405. <https://doi.org/10.1039/c7ra01238a>.
- Sathiskumar, P., Pugazhenthiran, N., Mangalaraja, R., Asiri, A., Anandan, S., 2013. *ZnO supported CoFe₂O₄ nanophotocatalysts for the mineralization of Direct Blue 71 in aqueous environments*. J Hazard Mater 252, 171.
- Selim, Y.A., Azb, M.A., Ragab, I., H. M. Abd El-Azim, M., 2020. *Green Synthesis of Zinc Oxide Nanoparticles Using Aqueous Extract of Deverra tortuosa and their Cytotoxic*

- Settle, F.A., 1998. *Handbook of Instrumental Techniques for Analytical Chemistry*. IEEE Electr. Insul. Mag. 14.
- Shabani, A., Nabiyouni, G., Saffari, J., Ghanbari, D., 2016. *Photo-catalyst Fe₃O₄/TiO₂ nanocomposites: green synthesis and investigation of magnetic nanoparticles coated on cotton*. J. Mater. Sci. Mater. Electron. 27, 8661–8669. <https://doi.org/10.1007/s10854-016-4887-5>.
- Shahid, M., Jingling, L., Ali, Z., Shakir, I., Warsi, M.F., Parveen, R.F., Nadeem, M., 2013. *Photocatalytic Degradation of Methylene Blue on Magnetically Separable MgFe₂O₄ under Visible Light Irradiation*. Mater. Chem. Phys. 139.
- Sharifianjazi, Fariborz, Mostafa Moradib, Nader, P., Ali, N., Azadeh, R.J., Niloufar, S., Aliasghar, A., Saeed, K., Zohre, A., Hossein, E.A., Mohammad, I., Amirhosein, P., Saeid, S., 2020. *Magnetic CoFe₂O₄ Nanoparticles Doped with Metal Ions: A Review*. Ceram. Int.
- Shreyash, N., Bajpai, S., Khan, M.A., Vijay, Y., Tiwary, S.K., Sonker, M., 2021. *Green Synthesis of Nanoparticles and Their Biomedical Applications: A Review*. ACS Appl. Nano Mater. 4, 11428–11457. <https://doi.org/10.1021/acsnm.1c02946>
- Siboni, M., Shirzad, M.T., Samadi, J.K., Yang, Lee, S.M., 2011. *Photocatalytic Reduction of Cr(VI) and Ni(II) in Aqueous Solution by Synthesized Nanoparticle ZnO under Ultraviolet Light Irradiation: A Kinetic Study*. Environ. Technol. 32, 1573–1579.
- Singh, J., Dutta, T., Kim, K.H., Rawat, M., Samddar, P., Kumar, P., 2018. “Green” synthesis of metals and their oxide nanoparticles: Applications for environmental remediation. J. Nanobiotechnology 16, 1–24. <https://doi.org/10.1186/s12951-018-0408-4>.
- Sonker, R.K., Hitkari, G., Sabhajeet, S.R., Sikarwar, S., Rahul, Singh, S., 2020. *Green synthesis of TiO₂ nanosheet by chemical method for the removal of Rhodamin B from industrial waste*. Mater. Sci. Eng. B 258. <https://doi.org/10.1016/j.mseb.2020.114577>.
- Speakman, S.A., 2012. *Basic of X-Ray Powder Diffraction*. Massachusetts Institute of Technology, Cambridge.
- Suharyadi, E., Muzakki, A., Istiqomah, N.I., Puspitarum, D.L., Purnama, B., Djuhana, D., 2022. *Reusability of photocatalytic CoFe₂O₄@ZnO core-shell nanoparticles for dye degradation*. ECS J. Solid State Sci. Technol. 11, 023004. <https://doi.org/10.1149/2162-8777/ac4c7c>.
- Suharyadi, E., Muzakki, A., Nofrianti, A., Istiqomah, N.I., Kato, T., Iwata, S., 2020. *Photocatalytic activity of magnetic core-shell CoFe₂O₄@ZnO nanoparticles for purification of methylene blue* Photocatalytic activity of magnetic core-shell CoFe₂

- Fe₃O₄@ZnO nanoparticles for purification of methylene blue*. Mater. Res. Express 7.
- Sunaryono, S., Fitriana, D.R., Novita, L.R., Hidayat, M.F., Hartatiek, H., Mufti, N., Taufiq, A., 2020. *The effect of Fe₃O₄ concentration to photocatalytic activity of Fe₃O₄@TiO₂-PVP core-shell nanocomposite*. J. Phys. Conf. Ser. 1595. <https://doi.org/10.1088/1742-6596/1595/1/012003>.
- Tedsree, K., Temnuch, N., Sriplai, N., Pinitsoontorn, S., 2017. *Ag modified Fe₃O₄@TiO₂ magnetic core-shell nanocomposites for photocatalytic degradation of methylene blue*. Mater. Today Proc. 4, 6576–6584. <https://doi.org/10.1016/j.matpr.2017.06.170>.
- Tumbelaka, R.M., Istiqomah, N.I., Kato, T., Oshima, D., Suharyadi, E., 2022. *High reusability of green-synthesized Fe₃O₄/TiO₂ photocatalyst nanoparticles for efficient degradation of methylene blue dye*. Mater. Today Commun. 33, 104450. <https://doi.org/10.1016/j.mtcomm.2022.104450>.
- Viet, P. Van, Tran, H.N., 2019. *Adsorption and photocatalytic degradation of methylene blue by titanium dioxide nanotubes at different pH conditions*. Adv. Nat. Sci. Nanosci. Nanotechnol. 10. <https://doi.org/10.1088/2043-6254/ab5100>.
- Vignesh, K., Suganthi, A., Min, B.K., Kang, M., 2014. *Photocatalytic activity of magnetically recoverable MnFe₂O₄/g-C₃N₄/TiO₂ nanocomposite under simulated solar light irradiation*. J. Mol. Catal. A Chem. 395, 373–383. <https://doi.org/10.1016/j.molcata.2014.08.040>.
- Vijayalaksmi, S., Sharmila, L., Vasudevan, D., 2018. *Photocatalytic oxidation using Cobalt Oxide nanoparticles for dye removal*. Indian J. Adv. Chem. Sci. 6, 122–129. <https://doi.org/10.22607/IJACS.2019.704004>.
- Vongsak, B., Sithisarn, P., Mangmool, S., Thongpraditchote, S., Wongkrajang, Y., Gritsanapan, W., 2013. *Maximizing total phenolics, total flavonoids contents and antioxidant activity of Moringa oleifera leaf extract by the appropriate extraction method*. Ind. Crops Prod. 44, 566–571. <https://doi.org/10.1016/j.indcrop.2012.09.021>.
- Waite, T., 2006. *Toxic organic destruction by electron beam irradiation: An innovative technology for developing countries*. University of Mia.
- Wang, J., Yang, J., Li, Xiuyan, Wang, D., Wei, B., Song, H., Li, Xuefei, Fu, S., 2016. *Preparation and photocatalytic properties of magnetically reusable Fe₃O₄@ZnO core/shell nanoparticles*. Phys. E Low-Dimensional Syst. Nanostructures 75, 66–71. <https://doi.org/10.1016/j.physe.2015.08.040>.
- Wardencki, W., Curyło, J., Namieśnik, J., 2005. *Green chemistry - Current and future issues*. Polish J. Environ. Stud. 14, 389–395.

- Widihati, I.A.G., Diantariani, N.P., Nikmah, Y.F., 2011. *Fotodegradasi metilen biru dengan sinar UV dan katalis Al₂O₃*. J. Kim. 5, 31–42.
- William, D., Carter, C., 1996. *Transmission electron microscopy*, Plenum Press, New York.
- Wilson, A., Mishra, S.R., Gupta, R., Ghosh, K., 2012. *Preparation and photocatalytic properties of hybrid core-shell reusable CoFe₂O₄-ZnO nanospheres*. J. Magn. Mater. 324, 2597–2601. <https://doi.org/10.1016/j.jmmm.2012.02.009>.
- Xia, Y., Yao, Q., Zhang, W., Zhang, Y., Zhao, M., 2019. *Comparative adsorption of methylene blue by magnetic baker's yeast and EDTAD-modified magnetic baker's yeast: Equilibrium and kinetic study*. Arab. J. Chem. 12, 2448–2456. <https://doi.org/10.1016/j.arabjc.2015.03.010>.
- Xiao, H.M., Liu, X.M., Fu, S.Y., 2006. *Synthesis, magnetic and microwave absorbing properties of core-shell structured MnFe₂O₄/TiO₂ nanocomposites*. Compos. Sci. Technol. 66, 2003–2008. <https://doi.org/10.1016/j.compscitech.2006.01.001>
- Xin, T., Ma, M., Zhang, H., Gu, J., Wang, S., Liu, M., Zhang, Q., 2014. *A facile approach for the synthesis of magnetic separable Fe₃O₄@TiO₂ core-shell nanocomposites as highly recyclable photocatalysts*. Appl. Surf. Sci. 288, 51–59. <https://doi.org/10.1016/j.apsusc.2013.09.108>.
- Yadav, N.G., Chaudhary, L.S., Sakhare, P.A., Dongale, T.D., Patil, P.S., Sheikh, A.D., 2018. *Impact of collected sunlight on ZnFe₂O₄ nanoparticles for photocatalytic application*. J. Colloid Interface Sci. 527, 289–297. <https://doi.org/10.1016/j.jcis.2018.05.051>.
- Yang, J., Zhang, J., Zou, B., Zhang, H., Wang, J., Schubert, U., Rui, Y., 2020. *Black SnO₂-TiO nanocomposites with high dispersion for photocatalytic and photovoltaic applications*. ACS Appl. Nano Mater. 3, 4265–4273. <https://doi.org/10.1021/acsanm.0c00432>.
- Yang, L.X., Li, S., Zhang, J., Chen, Z., Xu, S.C., 2014. *Preparation, characterization and magnetic property of MFe₂O₄ (M=Mn, Zn, Ni, Co) nanoparticles*. Adv. Mater. Res. 842, 35–38. <https://doi.org/10.4028/www.scientific.net/AMR.842.35>.
- Yang, Y., Guo, Y., Hu, C., Jiang, C., Wang, E., 2003. *Synergistic effect of Keggin type [X_n+W₁₁O₃₉](12-n)- and TiO₂ in macroporous hybrid materials [X_n+W₁₁O₃₉](12-n)-TiO₂ for the photocatalytic degradation of textile dyes [Review]*. J. Mater Chem 13, 1686–1694.
- Yokosuka, Y., Oki, K., Nishikiori, H., Tatsumi, Y., Tanaka, N., Fujii, T., 2009. *Photocatalytic degradation of trichloroethylene using N-doped TiO₂ prepared by a simple sol-gel process*. Res. Chem. Intermed. 35, 43–53. <https://doi.org/10.1007/s11164-008-0019-z>.
- Yuliati, L., Roslan, N.A., Siah, W.R., Lintang, H.O., 2017. *Cobalt oxide-modified titanium*

Indones. J. Chem. 17, 284–290. <https://doi.org/10.22146/ijc.22624>.

Yun, J., Sun, J., Oh, A., Jin, D., Bae, T., Lee, Y., Kim, H., 2011. *pH-sensitive photocatalytic activities of TiO₂/poly (vinyl alcohol)/ poly (acrylic acid) composite hydrogels.* Mater. Sci. engineering B 176, 276–281.

Zhang, B., Fu, W., Meng, X., Ruan, A., Su, P., Yang, H., 2017. *Synthesis and enhanced gas sensing properties of flower-like ZnO-Fe₂O₃.* Ceram. Int. 43, 5934–5940.

Zhang, G., Xu, W., Li, Z., Hu, W., Wang, Y., 2009. *Preparation and characterization of multi-functional CoFe₂O₄-ZnO nanocomposites.* J. Magn. Magn. Mater. 321, 1424–1427. <https://doi.org/10.1016/j.jmmm.2009.02.057>.

Zhang, Guaoxin, Xu, W., Li, Z., Hu, W., Wang, Y., 2009. *Preparation and characterization of multi-functional CoFe₂O₄-ZnO nanocomposites.* J. Magn. Magn. Mater. 321, 1424–1427.

Zhang, Y.H., Jiu, B.B., Gong, F.L., Lu, K., Jiang, N., Zhang, H.L., Chen, J.L., 2018. *Facile synthesis of core-shell Cu₂O@ZnO structure with enhanced photocatalytic H₂ production.* J. Phys. Chem. Solids 116, 126–130. <https://doi.org/10.1016/j.jpics.2018.01.024>.

Zhao, K., Feng, L., Li, Z., Fu, Y., Zhang, X., Wei, J., Wei, S., 2014. *Preparation, characterization and photocatalytic degradation properties of a TiO₂/calcium alginate composite film and the recovery of TiO₂ nanoparticles.* RSC Adv. 4, 51321–51329. <https://doi.org/10.1039/c4ra08102a>.

Zheng, J., Zili, L., Hao, P., Xiaogang, Z., 2019. *Core-shell Sm₂O₃@ZnO nano-heterostructure for the visible light driven photocatalytic performance.* Colloids Surfaces A Physicochem. Eng. Asp. 560, 244–251.

Zheng, Y., Liub, J., Chenga, B., Youa, W., Hoc, W., Tang, H., 2019. *Hierarchical porous Al₂O₃@ZnO core-shell microfibres with excellent adsorption affinity for congo red molecule.* Appl. Surf. Sci. 473, 251–260.