

DAFTAR PUSTAKA

- Abdullah, (2008). *Pengantar Nanosains*, Institut Teknologi Bandung, Bandung
- Adziimaa, A. F., Risanti, D. D., & Mawarni, L. J. (2013). Sintesis Natrium Silikat dari Lumpur Lapindo sebagai Inhibitor Korosi. *Jurnal Teknik ITS*, 2(2), 384–389.
- Afandi, S., 2006, Sintesa dan Karakterisasi Partikel Magnetik Submikron Berbasis Oksida Fe dan Polimer Polilaktat (PLA), *Skripsi*, Fakultas Matematika dan Ilmu Pengetahuan Alam, Institut Pertanian Bogor, Bogor
- Akhter, S., Paul, D. P., Hakim, A., & Saha, D. K. (2011). *Synthesis , Structural and Physical Properties of Cu 1 – x Zn x Fe 2 O 4 Ferrites*. 2011(November), 1675–1681.
- Al-Mamun, M. R., Kader, S., Islam, M. S., & Khan, M. Z. H. (2019). Photocatalytic activity improvement and application of UV-TiO₂ photocatalysis in textile wastewater treatment: A review. *Journal of Environmental Chemical Engineering*, 7(5). <https://doi.org/10.1016/j.jece.2019.103248>
- Bajorek, A., Berger, C., Dulski, M., Łopadczak, P., Zubko, M., Prusik, K., Wojtyniak, M., Chrobak, A., Grasset, F., & Randrianantoandro, N. (2019). Microstructural and magnetic characterization of Ni_{0.5}Zn_{0.5}Fe₂O₄ ferrite nanoparticles. *Journal of Physics and Chemistry of Solids*, 129(September 2018), 1–21. <https://doi.org/10.1016/j.jpcs.2018.12.045>
- Barad, J. M., Kohli, H. P., & Chakraborty, M. (2022). Adsorption of hexavalent chromium from aqueous stream by maghemite nanoparticles synthesized by the microemulsion method. *Energy Nexus*, 5(November 2021), 100035. <https://doi.org/10.1016/j.nexus.2021.100035>
- Baykal, A., Güner, S., Demir, A., Esir, S., & Genç, F. (2014). Effect of zinc substitution on magneto-optical properties of Mn_{1-x}Zn_xFe₂O₄/SiO₂ nanocomposites. *Ceramics International*, 40(8 PART B), 13401–13408. <https://doi.org/10.1016/j.ceramint.2014.05.059>
- Bhunia, A., Lahiri, D., Nag, M., Upadhye, V., & Pandit, S. (2022). Bacterial biofilm



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GREEN SYNTHESIS NANOPARTIKEL NiZnFe₂O₄/SiO₂, KARAKTERISASI DAN APLIKASINYA
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Universitas Gadjah Mada, 2023 | Diunduh dari <http://etd.repository.ugm.ac.id/>

- mediated bioremediation of hexavalent chromium: A review. *Biocatalysis and Agricultural Biotechnology*, 43(May), 102397. <https://doi.org/10.1016/j.bcab.2022.102397>
- Blundell, S., (2001). Magnetism in Condensed Matter. *Oxford University Press*, 80–81
- Callister Jr, W. D., & Rethwisch, D. G. (2018). Structures and Properties of Ceramics. In *Materials Science and Engineering - An Introduction*.
- Cao, J., Shi, T., Wang, H., Zhu, F., Wang, J., Wang, Y., Cao, F., & Su, E. (2023). Journal of Food Composition and Analysis *Moringa oleifera* leaf protein : Extraction , characteristics and applications. *Journal of Food Composition and Analysis*, 119(August 2022), 105234. <https://doi.org/10.1016/j.jfca.2023.105234>
- Cao, X., & Gu, L. (2005). Spindly cobalt ferrite nanocrystals: Preparation, characterization and magnetic properties. *Nanotechnology*, 16(2), 180–185. <https://doi.org/10.1088/0957-4484/16/2/002>
- Chen, D. G., Tang, X. G., Wu, J. B., Zhang, W., Liu, Q. X., & Jiang, Y. P. (2011). Effect of grain size on the magnetic properties of superparamagnetic Ni_{0.5}Zn_{0.5}Fe₂O₄ nanoparticles by co-precipitation process. *Journal of Magnetism and Magnetic Materials*, 323(12), 1717–1721. <https://doi.org/10.1016/j.jmmm.2011.02.002>
- Cheng, F. Y., Su, C. H., Yang, Y. S., Yeh, C. S., Tsai, C. Y., Wu, C. L., Wu, M. T., & Shieh, D. Bin. (2005). Characterization of aqueous dispersions of Fe₃O₄ nanoparticles and their biomedical applications. *Biomaterials*, 26(7), 729–738. <https://doi.org/10.1016/j.biomaterials.2004.03.016>
- Cong, H., Toftegaard, R., Arnbjerg, J., & Ogilby, P. R. (2010). Silica-coated gold nanorods with a gold overcoat: Controlling optical properties by controlling the dimensions of a gold-silica-gold layered nanoparticle. *Langmuir*, 26(6), 4188–4195. <https://doi.org/10.1021/la9032223>
- Deepak, P., Amutha, V., Kamaraj, C., Balasubramani, G., Aiswarya, D., & Perumal, P. (2019). Chemical and green synthesis of nanoparticles and their efficacy on cancer cells. In *Green Synthesis, Characterization and Applications of*



Nanoparticles. Elsevier Inc. <https://doi.org/10.1016/b978-0-08-102579-6.00016-2>

Demirezen, D. A., dan Yilmaz, D. D. (2018). Green synthesis and characterization of iron green synthesis and nanoparticles using Ficus. *Internal, April*, 25–29.

Deng, L., Shi, Z., Wang, L., & Zhou, S. (2017). Fabrication of a novel NiFe₂O₄/Zn-Al layered double hydroxide intercalated with EDTA composite and its adsorption behavior for Cr(VI) from aqueous solution. *Journal of Physics and Chemistry of Solids*, 104(January), 79–90. <https://doi.org/10.1016/j.jpcs.2016.12.030>

Du, F., Yang, D., Kang, T., Ren, Y., Hu, P., Song, J., Teng, F., & Fan, H. (2022). SiO₂/Ga₂O₃ nanocomposite for highly efficient selective removal of cationic organic pollutant via synergistic electrostatic adsorption and photocatalysis. *Separation and Purification Technology*, 295(April), 121221. <https://doi.org/10.1016/j.seppur.2022.121221>

Etemadinia, T., Allahrasani, A., & Barikbin, B. (2019). ZnFe₂O₄@SiO₂@Tragacanth gum nanocomposite: synthesis and its application for the removal of methylene blue dye from aqueous solution. *Polymer Bulletin*, 76(12), 6089–6109. <https://doi.org/10.1007/s00289-019-02681-7>

Etemadinia, T., Barikbin, B., & Allahresani, A. (2019). Removal of congo red dye from aqueous solutions using ZnFe₂O₄/sio₂/Tragacanth gum magnetic nanocomposite as a novel adsorbent. *Surfaces and Interfaces*, 14(October 2018), 117–126. <https://doi.org/10.1016/j.surfin.2018.10.010>

Fatimah, I., Amaliah, S. N., Andrian, M. F., Handayani, T. P., Nurillahi, R., Prakoso, I. P., (2019). Iron oxide nanoparticles supported on biogenic silica derived from bamboo leaf ash for rhodamine B photodegradation. *Sustainable Chemistry and Pharmacy*, 13, 100149, 1613–1629. <https://doi.org/10.1016/j.scp.2019.100149>.

Fatimah, I., Purwiandono, G., Sahroni, I., Sagadevan, S., Oh, W. C., Ghazali, S.A.I.S.M.G., Doong, R.A., (2022). I Recyclable Catalyst of ZnO/SiO₂ Prepared from Salacca Leaves Ash for Sustainable Biodiesel Conversion. *South African Journal of Chemical Engineering*, (40) 134–143.



UNIVERSITAS
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GREEN SYNTHESIS NANOPARTIKEL NiZnFe₂O₄/SiO₂, KARAKTERISASI DAN APLIKASINYA
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<https://doi.org/10.1016/j.sajce.2022.02.008>.

Friedrich, H., De Jongh, P. E., Verkleij, A. J., & De Jong, K. P. (2009). Electron tomography for heterogeneous catalysts and related nanostructured materials. *Chemical Reviews*, 109(5), 1613–1629. <https://doi.org/10.1021/cr800434t>

George, A., Raj, D. M. A., Raj, A. D., Nguyen, B. S., Phan, T. P., Pazhanivel, T., Sivashanmugan, K., Josephine, R. L., Irudayaraj, A. A., Arumugam, J., & Nguyen, V. H. (2020). Morphologically tailored CuO nanostructures toward visible-light-driven photocatalysis. *Materials Letters*, 281, 128603. <https://doi.org/10.1016/j.matlet.2020.128603>

Getzlaff, Mathias (2008). *Fundamentals of Magnetism*, Springer Berlin Heidelberg.

Ghasemi, A., & Mousavinia, M. (2014). Structural and magnetic evaluation of substituted NiZnFe₂O₄ particles synthesized by conventional sol-gel method. *Ceramics International*, 40(2), 2825–2834. <https://doi.org/10.1016/j.ceramint.2013.10.031>

He, Y., Zhang, L., Chen, G., Liu, Y., Shi, S., Jiang, P., Ding, J., Xu, S., & Geng, C. (2023). ZnO/SiO₂ encapsulation of perovskite nanocrystals for efficient and stable light-emitting diodes. *Applied Surface Science*, 611(PA), 155724. <https://doi.org/10.1016/j.apsusc.2022.155724>

Hosseini Nasab, N., & Safari, J. (2019). Synthesis of a wide range of biologically important spiropyrans and spiroacenaphthylenes, using NiFe₂O₄@SiO₂@Melamine magnetic nanoparticles as an efficient, green and reusable nanocatalyst. *Journal of Molecular Structure*, 1193, 118–124. <https://doi.org/10.1016/j.molstruc.2019.05.023>

Indrayana, I. P. T., Julian, T., & Suharyadi, E. (2018). UV Light-Driven Photodegradation of Methylene Blue by Using Mn_{0.5}Zn_{0.5}Fe₂O₄/SiO₂ Nanocomposites. *Journal of Physics: Conference Series*, 1011(1), 1–7. <https://doi.org/10.1088/1742-6596/1011/1/012062>

Ionescu, A., Llandro, J., & Ziebeck, K. R. A. (2019). Magnetism, magnetic materials, and nanoparticles. *Magnetic Nanoparticles in Biosensing and Medicine*, 1–51.



<https://doi.org/10.1017/9781139381222.002>

Istiqomah, N. I., Muzakki, A. T., Nofrianti, A., Suharyadi, E., Kato, T., & Iwata, S. (2020). The effect of silica on photocatalytic degradation of methylene blue using silica-coated nizn ferrite nanoparticles. *Key Engineering Materials*, 855 KEM, 268–273. <https://doi.org/10.4028/www.scientific.net/KEM.855.268>

Istiqomah, N. I., (2020). Photodegradasi methylene blue menggunakan Fotokatalis Nanopartikel ZnNi-Ferrite/Silika. *Thesis*. Universitas Gadjah Mada. Yogyakarta

Jacob, J. M., Rajan, R., Tom, T. C., Kumar, V. S., Kurup, G. G., Shanmuganathan, R., & Pugazhendhi, A. (2019). Biogenic design of ZnS quantum dots - Insights into their in-vitro cytotoxicity, photocatalysis and biosensing properties. *Ceramics International*, 45(18), 24193–24201.

<https://doi.org/10.1016/j.ceramint.2019.08.128>

Jain, S., dan Mehata, M. S. (2017). Medicinal plant leaf extract and pure flavonoid mediated green synthesis of silver nanoparticles and their enhanced antibacterial property. *Scientific Reports*, 7(1), 1–13.

Jesus, A.C.B., Jesus, J.R., Lima, R.J.S, Moura, K.O., Almeida, J.M.A., dan Duque, J.G.S. (2020). Synthesis and magnetic interaction on concentrated Fe₃O₄ nanoparticles obtained by the co-precipitation and hydrothermal chemical methods. *Ceramics International*, 46(8), pp. 11149–11153.

Jia, Z., Peng, K., & Xu, L. (2012). Preparation, characterization and enhanced adsorption performance for Cr(VI) of mesoporous NiFe₂O₄ by twice pore-forming method. *Materials Chemistry and Physics*, 136(2–3), 512–519. <https://doi.org/10.1016/j.matchemphys.2012.07.019>

John, B. C., Vijayasankar, A. V., Soorya, S. R., Sham A. M., (2023). Adsorptive removal of Cr (VI) using mesoporous iron-aluminum oxyhydroxide-polyvinyl alcohol self-supporting film: Kinetics, optimization studies and mechanism, *Material Today Communications*, 34 (2023) 105315. <https://doi.org/10.1016/j.mtcomm.2023.105315>.

Joseph, J., Tangsali, R. B., Pillai, V. P. M., Choudhary, R. J., Phase, D. M., &



- Ganeshan, V. (2015). Structure and magnetic properties of highly textured nanocrystalline Mn-Zn ferrite thin film. *Physica B: Condensed Matter*, 456, 293–297. <https://doi.org/10.1016/j.physb.2014.09.015>
- Kaewmanee, T., Phuruangrat, A., Thongtem, T., & Thongtem, S. (2020). Solvothermal synthesis of Mn-Zn Ferrite(core)@SiO₂(shell)/BiOBr_{0.5}Cl_{0.5} nanocomposites used for adsorption and photocatalysis combination. *Ceramics International*, 46(3), 3655–3662. <https://doi.org/10.1016/j.ceramint.2019.10.085>
- Kalappurayil, T. M., & Joseph, B. P. (2017). A review of pharmacognostical studies on *moringa oleifera* Lam. Flowers. *Pharmacognosy Journal*, 9(1), 1–7. <https://doi.org/10.5530/pj.2017.1.1>
- Kareem, S. H., Ati, A. A., Shamsuddin, M., & Lee, S. L. (2015). Nanostructural, morphological and magnetic studies of PEG/Mn_(1-x)Zn_(x)Fe₂O₄ nanoparticles synthesized by co-precipitation. *Ceramics International*, 41(9), 11702–11709. <https://doi.org/10.1016/j.ceramint.2015.05.134>
- Kareem, S. H., Ooi, Y. K., Abdulnoor, S. S., Shamsuddin, M., & Lee, S. L. (2014). Influence of zinc on the structure and morphology of manganese ferrite nanoparticles. *Jurnal Teknologi (Sciences and Engineering)*, 69(5), 103–106. <https://doi.org/10.11113/jt.v69.3214>
- Kathiravan, A., Renganathan, R., & Anandan, S. (2009). Interaction of colloidal AgTiO₂ nanoparticles with bovine serum albumin. *Polyhedron*, 28(1), 157–161. <https://doi.org/10.1016/j.poly.2008.09.023>
- Kermani, M., Kakavandi, B., Farzadkia, M., Esrafil, A., Jokandan, S.F., dan Shahsavani, A. (2018). Catalytic ozonation of high concentrations of catechol over TiO₂@Fe₃O₄ magnetic core-shell nanocatalyst: Optimization, toxicity and degradation pathway studies. *Journal of Cleaner Production*, 192, pp. 597–607
- Khojastehnezhad, A., Rahimizadeh, M., Moeinpour, F., Eshghi, H., & Bakavoli, M. (2014). Polyphosphoric acid supported on silica-coated NiFe₂O₄ nanoparticles: An efficient and magnetically-recoverable catalyst for N-formylation of amines.



Comptes Rendus Chimie, 17(5), 459–464.

<https://doi.org/10.1016/j.crci.2013.07.013>

Kiani Nejad, Z., Mirzaei-Kalar, Z., & Khandar, A. A. (2021). Synthesis of ZnFe₂O₄@SiO₂ nanoparticles as a pH-sensitive drug release system and good nano carrier for CT-DNA binding. *Journal of Molecular Liquids*, 339, 117155. <https://doi.org/10.1016/j.molliq.2021.117155>

Kiran, M. S., Rajith Kumar, C. R., Shwetha, U. R., Onkarappa, H. S., Betageri, V. S., & Latha, M. S. (2021). Green synthesis and characterization of gold nanoparticles from *Moringa oleifera* leaves and assessment of antioxidant, antidiabetic and anticancer properties. *Chemical Data Collections*, 33, 100714. <https://doi.org/10.1016/j.cdc.2021.100714>

Kiwaan, H.A., Atwee, T.M., Azab, E.A., dan El-Binary, A.A. (2020). Photocatalytic degradation of organic dyes in the presence of nanostructured titanium dioxide. *Journal of Molecular Structure*, 1200, p. 127115.

Kralj, S., Drofenik, M., & Makovec, D. (2011). Controlled surface functionalization of silica-coated magnetic nanoparticles with terminal amino and carboxyl groups. *Journal of Nanoparticle Research*, 13(7), 2829–2841. <https://doi.org/10.1007/s11051-010-0171-4>

Lakshmananan, A., Surendran, P., Priya, S. S., Balakrishnan, K., Geetha P., Rameshkumar, P., Hedge, T. A., Vinitha, G., & Kannan, K., (2020). Investigations on structural, optical, dielectric, electronic polarizability Z-scan and antibacterial properties of Ni/Zn/Fe₂O₄ nanoparticles fabricated by microwave-assisted combustion method. *Journal of Photochemistry & Photobiology A : Chemistry*. <https://doi.org/10.1016/j.jphotochem.2020.112794>

Latif, S., Liaqat, A., Imran, M., Javaid, A., Hussain, N., Jasionowski, T., & Bilal, M. (2023). Development of zinc ferrite nanoparticles with enhanced photocatalytic performance for remediation of environmentally toxic pharmaceutical waste diclofenac sodium from wastewater. *Environmental Research*, 216(P2), 114500. <https://doi.org/10.1016/j.envres.2022.114500>



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GREEN SYNTHESIS NANOPARTIKEL NiZnFe₂O₄/SiO₂, KARAKTERISASI DAN APLIKASINYA
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Haryani, Prof. Dr. Eng. Edi Suharyadi, M. Eng.

Universitas Gadjah Mada, 2023 | Diunduh dari <http://etd.repository.ugm.ac.id/>

- Leaves, L., Anzano, A., Falco, B. De, Ammar, M., Ricciardelli, A., Grauso, L., Sabbah, M., Capparelli, R., & Lanzotti, V. (2022). *Chemical Analysis and Antimicrobial Activity of Moringa oleifera Lam. Leaves and Seeds*. 1–12.
- Lee, H., Park, Y. K., Kim, S. J., Kim, B. H., & Jung, S. C. (2015). Titanium dioxide modification with cobalt oxide nanoparticles for photocatalysis. *Journal of Industrial and Engineering Chemistry*, 32, 259–263. <https://doi.org/10.1016/j.jiec.2015.08.025>
- Li, C. J., Zhang, Y. J., Chen, H., He, P. Y., Zhang, Y., & Meng, Q. (2021). Synthesis of fly ash cenospheres-based hollow ABW zeolite for dye removal via the coupling of adsorption and photocatalysis. *Advanced Powder Technology*, 32(10), 3436–3446. <https://doi.org/10.1016/j.apt.2021.07.029>
- Likasari, I. D., Astuti, R. W., Yahya, A., Isnaini, N., Purwiandono, G., Hidayat, H., Wicaksono, W. P., & Fatimah, I. (2021). NiO nanoparticles synthesized by using *Tagetes erecta L* leaf extract and their activities for photocatalysis, electrochemical sensing, and antibacterial features. *Chemical Physics Letters*, 780(July), 138914. <https://doi.org/10.1016/j.cplett.2021.138914>
- Lin, K.Y.A. dan Zhang, Z.Y. (2017). Degradation of Bisphenol A using peroxymonosulfate activated by one-step prepared sulfur-doped carbon nitride as a metal-free heterogeneous catalyst. *Chemical Engineering Journal*, 313, pp. 1320–1327
- Lin, H., Zhu, H., Tan, J., Wang, H., Wang, Z., Li, P., Zhao, C., & Liu, J. (2019). Comparative Analysis of Chemical Constituents of *Moringa oleifera* Leaves from China and India by Ultra-Performance Liquid Chromatography Coupled with Quadrupole-Time-Of-Flight Mass Spectrometry. *Molecules*, 24(5). <https://doi.org/10.3390/molecules24050942>
- Linsebigler, A. L., Lu, G., & Yates, J. T. (1995). Photocatalysis on TiO₂ Surfaces: Principles, Mechanisms, and Selected Results. *Chemical Reviews*, 95(3), 735–758. <https://doi.org/10.1021/cr00035a013>
- Liu, R., Shen, X., Jiang, C., Song, F., & Li, H. (2012). Preparation of



Ni_{0.5}Zn_{0.5}Fe₂O₄/SiO₂ nanocomposites and their adsorption of bovine serum albumin. *Journal of Alloys and Compounds*, 511(1), 163–168. <https://doi.org/10.1016/j.jallcom.2011.09.020>

López, P., G., Silvetti, S. P., Aguirre, M. del C., & Condó, A. M. (2009). Synthesis and characterization of (NiZnFe₂O₄)_{0.5}/(SiO₂)_{0.5} granular nanocomposites. *Journal of Alloys and Compounds*, 487(1–2), 646–652. <https://doi.org/10.1016/j.jallcom.2009.07.184>

Lv, H., Ma, L., Zeng, P., Ke, D., & Peng, T. (2010). Synthesis of fluorinated ZnFe₂O₄ with porous nanorod structures and its photocatalytic hydrogen production under visible light. *Journal of Materials Chemistry*, 20(18), 3665–3672. <https://doi.org/10.1039/b919897k>

Ma, L., & Ding, S. jing. (2018). Synthesis of thermostable Au@ZnO core-shell nanorods with efficient visible-light photocatalytic activity. *Materials Letters*, 217, 255–258. <https://doi.org/10.1016/j.matlet.2018.01.080>

Makarov, V. V., Love, A. J., Sinitsyna, O. V., Makarova, S. S., Yaminsky, I. V., Taliantsky, M. E., & Kalinina, N. O. (2014). “Green” nanotechnologies: Synthesis of metal nanoparticles using plants. *Acta Naturae*, 6(20), 35–44. <https://doi.org/10.32607/20758251-2014-6-1-35-44>

Makofane, A., Motaung, D. E., & Hintsho-Mbita, N. C. (2021). Photocatalytic degradation of methylene blue and sulfisoxazole from water using biosynthesized zinc ferrite nanoparticles. *Ceramics International*, 47(16), 22615–22626. <https://doi.org/10.1016/j.ceramint.2021.04.274>

Malega, F., Indrayana, I. P. T., & Suharyadi, E. (2018). Synthesis and Characterization of the Microstructure and Functional Group Bond of Fe₃O₄ Nanoparticles from Natural Iron Sand in Tobelo North Halmahera. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, 7(2), 129–138. <https://doi.org/10.24042/jipfalbiruni.v7i2.2913>

Mcmahon, G. (2007). Instrumentation A Guide to Laboratory , Miniaturized Instruments. *Analytical Instrumentation*.

Mehmood, S., Mahmood, M., Núñez-Delgado, A., Alatalo, J. M., Elrys, A. S., Rizwan,



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GREEN SYNTHESIS NANOPARTIKEL NiZnFe₂O₄/SiO₂, KARAKTERISASI DAN APLIKASINYA
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Universitas Gadjah Mada, 2023 | Diunduh dari <http://etd.repository.ugm.ac.id/>

- M., Weng, J., Li, W., & Ahmed, W. (2022). A green method for removing chromium (VI) from aqueous systems using novel silicon nanoparticles: Adsorption and interaction mechanisms. *Environmental Research*, 213(June). <https://doi.org/10.1016/j.envres.2022.113614>
- Meng, X. (2019). Recent Progress of Graphene as Cathode materials in Lithium Ion Batteries. *IOP Conference Series: Earth and Environmental Science*, 300(4). <https://doi.org/10.1088/1755-1315/300/4/042039>
- Miclescu, A., & Wiklund, L. (2010). Methylene blue, an old drug with new indications? *Jurnalul Roman de Anestezie Terapie Intensiva/Romanian Journal of Anaesthesia and Intensive Care*, 17(1), 35–41.
- Mijarsh, M. J. A., Megat Johari, M. A., & Ahmad, Z. A. (2015). Effect of delay time and Na₂SiO₃ concentrations on compressive strength development of geopolymers synthesized from TPOFA. *Construction and Building Materials*, 86, 64–74. <https://doi.org/10.1016/j.conbuildmat.2015.03.078>
- Mishra, J., Singh, G., Kaur, N., & Ganguli, A. K. (2023). Role of linker molecules on morphology of tripodal ligands based functionalized ZnO nanoparticles and its effect on photocatalysis. *Inorganic Chemistry Communications*, 148(July 2022), 110333. <https://doi.org/10.1016/j.inoche.2022.110333>
- Mody, V. V., Singh, A., & Wesley, B. (2013). Basics of magnetic nanoparticles for their application in the field of magnetic fluid hyperthermia. *European Journal of Nanomedicine*, 5(1), 11–21. <https://doi.org/10.1515/ejnm-2012-0008>
- Mohan, H., Muthukumar Sathya, P., Vadivel, S., Ha, G. H., Oh, H. S., Kim, G., Seralathan, K. K., & Shin, T. (2022). Highly efficient visible light photocatalysis of Ni_xZn_{1-x}Fe₂O₄ (x= 0, 0.3, 0.7) nanoparticles: Diclofenac degradation mechanism and eco-toxicity. *Chemosphere*, 301(April), 134699. <https://doi.org/10.1016/j.chemosphere.2022.134699>
- Mohseni, H., Shokrollahi, H., Sharifi, I., & Gheisari, K. (2012). Magnetic and structural studies of the Mn-doped Mg-Zn ferrite nanoparticles synthesized by the glycine nitrate process. *Journal of Magnetism and Magnetic Materials*, 324(22),



3741–3747.

- Naik, P. P., Tangsali, R. B., Sonaye, B., & Sugur, S. (2015). Radiation induced structural and magnetic transformations in nanoparticle Mn_xZn_(1-x)Fe₂O₄ ferrites. *Journal of Magnetism and Magnetic Materials*, 385, 377–385. <https://doi.org/10.1016/j.jmmm.2015.03.032>
- Narayanan, K. B., & Sakthivel, N. (2011). Green synthesis of biogenic metal nanoparticles by terrestrial and aquatic phototrophic and heterotrophic eukaryotes and biocompatible agents. *Advances in Colloid and Interface Science*, 169(2), 59–79. <https://doi.org/10.1016/j.cis.2011.08.004>
- Naseri, M., Kamalianfar, A., Naderi, E., & Hashemi, A. (2020). The effect of Ag nanoparticles on physical and photocatalytic properties of ZnFe₂O₄/SiO₂ nanocomposite. *Journal of Molecular Structure*, 1206, 127706. <https://doi.org/10.1016/j.molstruc.2020.127706>
- Natelson, D. (2015). Nanostructures and nanotechnology. In *Nanostructures and Nanotechnology*. Cambridge University Press. <https://doi.org/10.1017/CBO9781139025485>
- Nejad, Z. K., Kalar, Z. M., & Khandar, A. A., (2021). Synthesis of ZnFe₂O₄/SiO₂ nanoparticles as a pH-sensitive drug release system and good nano carrier for CT-BNA binding. *Journal of Molecular Liquids*. <https://doi.org/10.1016/j.molliq.2021.117155>
- Nimisha, O. K., Akshay, M., Manya, S., & Reena Mary, A. P. (2022). Synthesis and photocatalytic activity of nickel doped zinc ferrite. *Materials Today: Proceedings*, 4(xxxx), 2–5. <https://doi.org/10.1016/j.matpr.2022.06.332>
- Nishio, K., Ikeda, M., Gokon, N., Tsubouchi, S., Narimatsu, H., Mochizuki, Y., Sakamoto, S., Sandhu, A., Abe, M., & Handa, H. (2007). Preparation of size-controlled (30-100 nm) magnetite nanoparticles for biomedical applications. *Journal of Magnetism and Magnetic Materials*, 310(2 SUPPL. PART 3), 2408–2410. <https://doi.org/10.1016/j.jmmm.2006.10.795>
- Nuryono, N., Mutia Rosiati, N., Rusdiarso, B., Sakti, S. C. W., & Tanaka, S. (2014).



UNIVERSITAS
GADJAH MADA

GREEN SYNTHESIS NANOPARTIKEL NiZnFe₂O₄/SiO₂, KARAKTERISASI DAN APLIKASINYA
SEBAGAI FOTOKATALIS DAN
ADSORBEN LIMBAH CAIR

Haryani, Prof. Dr. Eng. Edi Suharyadi, M. Eng.

Universitas Gadjah Mada, 2023 | Diunduh dari <http://etd.repository.ugm.ac.id/>

- Coating of magnetite with mercapto modified rice hull ash silica in a one-pot process. *Journal of the Korean Physical Society*, 3(1), 1–12. <https://doi.org/10.1186/2193-1801-3-515>
- Pankhurst, Q. A., Thanh, N. K. T., Jones, S. K., & Dobson, J. (2009). Progress in applications of magnetic nanoparticles in biomedicine. *Journal of Physics D: Applied Physics*, 42(22). <https://doi.org/10.1088/0022-3727/42/22/224001>
- Patnaik, S., Das, K. K., Mohanty, A., & Parida, K. (2018). Enhanced photo catalytic reduction of Cr (VI) over polymer-sensitized g-C₃N₄/ZnFe₂O₄ and its synergism with phenol oxidation under visible light irradiation. *Catalysis Today*, 315 (November 2017), 52–66. <https://doi.org/10.1016/j.cattod.2018.04.008>
- Peng, L., wang, Q., Li, X., Zhang, C., (2009). Investigation of the states of water and OH groups on the surface of silica. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 334 (November 2017), 112–115. <https://doi.org/10.1016/j.colsurfa.2008.10.028>
- Plouffe, B. D. 2014. Fundamentals And Application of Magnetic Particles in Cell Isolation and Enrichment: A review. *IOP Publishing: Reports and Progress in Physics*. 78(1), 1-38
- Polte, J. (2015). Fundamental growth principles of colloidal metal nanoparticles - a new perspective. *CrystEngComm*, 17(36), 6809–6830. <https://doi.org/10.1039/c5ce01014d>
- Pozo López, G., Silvetti, S. P., Aguirre, M. del C., & Condó, A. M. (2009). Synthesis and characterization of (NiZnFe₂O₄)_{0.5}/(SiO₂)_{0.5} granular nanocomposites. *Journal of Alloys and Compounds*, 487(1–2), 646–652. <https://doi.org/10.1016/j.jallcom.2009.07.184>
- Preethi, D. R. A., & Philominal, A. (2022). Green Synthesis of Pure and Silver Doped Copper Oxide Nanoparticles using *Moringa Oleifera* Leaf Extract. *Materials Letters: X*, 13, 100122. <https://doi.org/10.1016/j.mlblux.2022.100122>
- Punia, P., Aggarwal, R. K., Kumar, R., Dhar, R., Thakur, P., & Thakur, A. (2022). Adsorption of Cd and Cr ions from industrial wastewater using Ca doped Ni-Zn



- nanoferrites: Synthesis, characterization and isotherm analysis. *Ceramics International*, 48(13), 18048–18056.
<https://doi.org/10.1016/j.ceramint.2022.02.234>
- 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. *Advances in Natural Sciences: Nanoscience and Nanotechnology*, 13(4), 45003. <https://doi.org/10.1088/2043-6262/ac996b>
- Range, K., M, D., & Moser, Y. A. (2012). Fundamentals and Application of Magnetic Particles in Cell Isolation and Enrichment. *NIH Public Access. Bone*, 23(1), 1–7.
<https://doi.org/10.1088/0034-4885/78/1/016601>
- Reddy, L. H., Arias, J. L., Nicolas, J., dan Couvreus, P., 2012, Magnetic Nanoparticle: Design and Characterization, Toxicity and Biocompatibility, Pharmaceutical and Biomedical Applications, *Chemical. Reviewer.*, volume 112, pp. 5818-5878
- Reimer, L., & Kohl, H. (2008). *Transmission electron microscopy : physics of image formation*.Springer.
- Rosales-González, O., Bolarín-Miró, A. M., Cortés-Escobedo, C. A., Pedro-García, F., Patiño-Pineda, J. A., & Sánchez-De Jesús, F. (2022). Synthesis of a magnetically removable visible-light photocatalyst based on nickel-doped zinc ferrite. *Ceramics International*, September, 1–9.
<https://doi.org/10.1016/j.ceramint.2022.10.101>
- Safa dan Capper (2007). *Springer Handbook of Electronic and Photonic Materials*. Springer. New York.
- Said, M. I., & Ibrahim, M. (2019). Controlled synthesis of iron oxide NPs derived from conventionally and ultrasonically prepared iron(III) coordination polymer: Potential remediation and catalytic degradation of methylene blue. *Materials Chemistry and Physics*, 233(lvi), 329–338.
<https://doi.org/10.1016/j.matchemphys.2019.05.044>



- Sen, T. K. (2013). Review on Dye Removal from Its Aqueous Solution into Alternative Cost Effective and Non-Conventional Adsorbents. *Journal of Chemical and Process Engineering*, 1. <https://doi.org/10.17303/jce.2014.105>
- Sertkol, M., Köseoğlu, Y., Baykal, A., Kavas, H., & Toprak, M. S. (2010). Synthesis and magnetic characterization of Zn_{0.7}Ni_{0.3}Fe₂O₄ nanoparticles via microwave-assisted combustion route. *Journal of Magnetism and Magnetic Materials*, 322(7), 866–871. <https://doi.org/10.1016/j.jmmm.2009.11.018>
- Shakour, Z. T. A., El-Akad, R. H., Elshamy, A. I., El Gendy, A. E. N. G., Wessjohann, L. A., & Farag, M. A. (2022). Dissection of *Moringa oleifera* leaf metabolome in context of its different extracts, origin and in relationship to its biological effects as analysed using molecular networking and chemometrics. *Food Chemistry*, 399(August 2022), 133948. <https://doi.org/10.1016/j.foodchem.2022.133948>
- Shahane, G. S., Kumar, A., Arora, M., Pant, R. P., & Lal, K. (2010). Synthesis and characterization of Ni-Zn ferrite nanoparticles. *Journal of Magnetism and Magnetic Materials*, 322(8), 1015–1019. <https://doi.org/10.1016/j.jmmm.2009.12.006>
- Sharma, P., Prakash, J., Palai, T., & Kaushal, R. (2022). Surface functionalization of bamboo leave mediated synthesized SiO₂ nanoparticles: Study of adsorption mechanism, isotherms and enhanced adsorption capacity for removal of Cr (VI) from aqueous solution. *Environmental Research*, 214(P1), 113761. <https://doi.org/10.1016/j.envres.2022.113761>
- Singh, A., Katakan, S., Ilavsky, J., Dahotre, N. B., & Harimkar, S. P. (2013). Nanocrystallization in spark plasma sintered Fe₄₈Cr₁₅Mo₁₄Y₂C₁₅B₆ bulk amorphous alloy. *Journal of Applied Physics*, 114(5). <https://doi.org/10.1063/1.4817379>
- Suharyadi, E., Muzakki, A. T., Nofrianti, A., Istiqomah, N. I., Kato, T., & Iwata, S. (2020). Photocatalytic activity of magnetic core-shell CoFe₂O₄@ZnO nanoparticles for purification of methylene blue. *IOP Publishing mater Res Express*, 7(085013). <https://doi.org/10.1088/2053-1591/abafdf>



- Suharyadi, E. (2012). *Buku Ajar Matakuliah Fisika Zat Padat. Lab Fisika Material & Instrumentasi*. FMIPA, UGM, Yogyakarta.
- Tawainella, R. D., Riana, Y., Fatayati, R., Ammeliya, Kato, T., Iwata, S. dan Suharyadi, E. 2014. Sintesis dan Karakterisasi Sifat Kemagnetan Nanopartikel Manganese Ferrite ($MnFe_2O_4$) dengan Metode Kopresipitasi. *Jurnal Fisika Indonesia*. 18(52), 1-7
- Tebriani, S. (2019). Analisis Vibrating Sample Magnetometer (VSM) Pada Hasil Elektrodepositi Lapisan Tipis Magnetite Menggunakan Aruscontinue Direct Current. *Natural Science Journal*, 5(1), 722–730.
- Thakur, A., Kumar, P., Thakur, P., Rana, K., Chevalier, A., Mattei, J. L., & Queffélec, P. (2016). Enhancement of magnetic properties of $Ni_{0.5}Zn_{0.5}Fe_2O_4$ nanoparticles prepared by the coprecipitation method. *Ceramics International*, 42(9), 10664–10670. <https://doi.org/10.1016/j.ceramint.2016.03.173>
- Trouillas, P., Marsal, P., Siri, D., Lazzaroni, R., & Duroux, J. L. (2006). A DFT study of the reactivity of OH groups in quercetin and taxifolin antioxidants: The specificity of the 3-OH site. *Food Chemistry*, 97(4), 679–688. <https://doi.org/10.1016/j.foodchem.2005.05.042>
- Tumbelaka, R. M., Istiqomah, N. I., Mabarroh, N., & Suharyadi, E. (2022). Green Synthesis of Fe_3O_4/TiO_2 Nanoparticles Using Extracts of *Moringa oleifera*: Microstructural and Optical Properties. *Solid State Phenomena*, 332, 91–99. <https://doi.org/10.4028/p-oi81sf>
- Tumbelaka, R. M., Istiqomah, N. I., Kato, T., Oshima, D., & Suharyadi, E. (2022). High reusability of green-synthesized Fe_3O_4/TiO_2 photocatalyst nanoparticles for efficient degradation of methylene blue dye. *Materials Today Communications*, 33, 104450. <https://doi.org/10.1016/j.mtcomm.2022.104450>
- Umut, E. (2013). Surface Modification of Nanoparticles Used in Biomedical Applications. *Modern Surface Engineering Treatments*. <https://doi.org/10.5772/55746>
- Vishwanath, R., & Negi, B. (2021). Conventional and green methods of synthesis of



silver nanoparticles and their antimicrobial properties. *Current Research in Green and Sustainable Chemistry*, 4(October), 100205.
<https://doi.org/10.1016/j.crgsc.2021.100205>

Wahajuddin, & Arora, S. (2012). Superparamagnetic iron oxide nanoparticles: Magnetic nanoplatforms as drug carriers. *International Journal of Nanomedicine*, 7, 3445–3471. <https://doi.org/10.2147/IJN.S30320>

Walock, M. (2012). Nanocomposite coatings based on quaternary metalnitrogen. *University of Alabama at Birmingham*, 189.

Wang, Z. L. (2004). Zinc oxide nanostructures: Growth, properties and applications. *Journal of Physics Condensed Matter*, 16(25). <https://doi.org/10.1088/0953-8984/16/25/R01>

Wu, K. H., Ting, T. H., Li, M. C., & Ho, W. D. (2006). Sol-gel auto-combustion synthesis of SiO₂-doped NiZn ferrite by using various fuels. *Journal of Magnetism and Magnetic Materials*, 298(1), 25–32.
<https://doi.org/10.1016/j.jmmm.2005.03.008>

Yang, H., Zhuang, Y., Hu, H., Du, X., Zhang, C., Shi, X., Wu, H., & Yang, S. (2010). Silica-coated manganese oxide nanoparticles as a platform for targeted magnetic resonance and fluorescence imaging of cancer cells. *Advanced Functional Materials*, 20(11), 1733–1741. <https://doi.org/10.1002/adfm.200902445>

Younas, M., Hidayat, M., Khurshid, M., Khan, A., Zeshan, M., Ahmad, I., & Nazim, M. (2023). *Moringa oleifera* leaf extract mediated green synthesis of silver nanoparticles and their antibacterial effect against selected gram-negative strains. *Biochemical Systematics and Ecology*, 107(October 2022), 104605.
<https://doi.org/10.1016/j.bse.2023.104605>

Yulizar, Y., Apriandaru, D. O. B., & Zahra, Z. A. (2021). SiO₂/NiFe₂O₄ nanocomposites: Synthesis, characterization and their catalytic activity for 4-nitroaniline reduction. *Materials Chemistry and Physics*, 261(January), 124243.
<https://doi.org/10.1016/j.matchemphys.2021.124243>

Zhang, S., Fan, X., & Xue, J. (2022). A novel magnetic manganese oxide halloysite



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**GREEN SYNTHESIS NANOPARTIKEL NiZnFe₂O₄/SiO₂, KARAKTERISASI DAN APLIKASINYA
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composite by one-pot synthesis for the removal of methylene Blue from aqueous solution. *Journal of Alloys and Compounds*. Elsevier.

<https://doi.org/10.1016/j.jallcom.2022.167050>