

DAFTAR PUSTAKA

- Agorku, E.S., Kuvarega, A.T., Mamba, B.B., Pandey, A.C. dan Mishra, A.K., 2015, Enhanced visible-light photocatalytic activity of multi-elements-doped ZrO₂ for degradation of indigo carmine, *J. Rare Earths*, 33, 498–506.
- Agrios, A.G. dan Pichat, P., 2005, State of the art and perspectives on materials and applications of photocatalysis over TiO₂, *J. Appl. Electrochem.*, 35, 655–663.
- Ajmal, A., Majeed, I., Malik, R.N., Iqbal, M., Nadeem, M.A., Hussain, I., Yousuf, S., Zeshan, Mustafa, G., Zafar, M.I. dan Nadeem, M.A., 2016, Photocatalytic degradation of textile dyes on Cu₂O-CuO/TiO₂ anatase powders, *J. Environ. Chem. Eng.*, 4, 2138–2146.
- Al-Mamun, M.R., Kader, S., Islam, M.S. dan Khan, M.Z.H., 2019, Photocatalytic activity improvement and application of UV-TiO₂ photocatalysis in textile wastewater treatment: A review, *J. Environ. Chem. Eng.*, 7, 103248.
- Alfarisa, S., Rifai, D.A. dan Toruan, P.L., 2018, Studi Difraksi Sinar-X Struktur Nano Seng Oksida (ZnO), *Risalah Fisika*, 2, 53–57.
- Ali, Zulfiqar, Shah, A. ullah, Ali, Zahid dan Mahmood, A., 2020, Influence of Cu modified surface states by sol gel technique on photocatalytic activity of titanium dioxide, *Mater. Chem. Phys.*, 249, 123169.
- Alkorbi, A.S., Muhammad Asif Javed, H., Hussain, S., Latif, S., Mahr, M.S., Mustafa, M.S., Alsaiari, R. dan Alhemiary, N.A., 2022, Solar light-driven photocatalytic degradation of methyl blue by carbon-doped TiO₂ nanoparticles, *Opt. Mater. (Amst)*, 127, 112259.
- Ameta, R. dan Ameta, S.C., 2017, *Photocatalysis*, CRC Press, Boca Raton.
- Andita, K.R., Kurniawan, R. dan Syoufian, A., 2019, Synthesis and characterization of Cu-doped zirconium titanate as a potential visible-light responsive photocatalyst, *Indones. J. Chem.*, 19, 761–766.
- Anwar, D.I. dan Mulyadi, D., 2015, Synthesis of Fe-TiO₂ composite as a photocatalyst for degradation of methylene blue, *Procedia Chem.*, 17, 49–54.
- Baiju, K. V, Shukla, S., Sandhya, K.S., James, J. dan Warriar, K.G.K., 2007, Photocatalytic activity of sol-gel-derived nanocrystalline titania, *J. Phys. Chem. C*, 111, 7612–7622.
- Basavarajappa, P.S., Patil, S.B., Ganganagappa, N., Reddy, K.R., Raghu, A. V. dan Reddy, C.V., 2020, Recent progress in metal-doped TiO₂, non-metal doped/codoped TiO₂ and TiO₂ nanostructured hybrids for enhanced photocatalysis, *Int. J. Hydrogen Energy*, 45, 7764–7778.

- Budiarto, B., Antonius, D. dan Putra, B.A., 2020, Analisis pengaruh waktu artificial age terhadap kekerasan, densitas dan struktur kristal paduan alumunium (7075) untuk bahan sirip roket, *J. Kaji. Ilm.*, 20, 13–28.
- Byrne, C., Moran, L., Hermosilla, D., Merayo, N., Blanco, Á., Rhatigan, S., Hinder, S., Ganguly, P., Nolan, M. dan Pillai, S.C., 2019, Effect of Cu doping on the anatase-to-rutile phase transition in TiO₂ photocatalysts: Theory and experiments, *Appl. Catal. B Environ.*, 246, 266–276.
- Dhonde, M., Sahu Dhonde, K., Purohit, K. dan Murty, V.V.S., 2019, Facile synthesis of Cu/N co-doped TiO₂ nanoparticles and their optical and electrical properties, *Indian J. Phys.*, 93, 27–32.
- Fu, X., Clark, L.A., Yang, Q. dan Anderson, M.A., 1996, Enhanced photocatalytic performance of titania-based binary metal oxides: TiO₂/SiO₂ and TiO₂/ZrO₂, *Environ. Sci. Technol.*, 30, 647–653.
- Fujishima dan Honda, K., 1972, Electrochemical photolysis of water at a semiconductor electrode, *Nature*, 238, 37–38.
- Gopal, R., Sambandam, A., Kuppulingam, T., Meenakshisundaram, S., AlSalhi, M.S. dan Devanesan, S., 2020, Versatile fabrication and characterization of Cu-doped ZrO₂ nanoparticles: enhanced photocatalytic and photoluminescence properties, *J. Mater. Sci. Mater. Electron.*, 31, 7232–7246.
- Gurushantha, K., Anantharaju, K.S., Nagabhushana, H., Sharma, S.C., Vidya, Y.S., Shivakumara, C., Nagaswarupa, H.P., Prashantha, S.C. dan Anilkumar, M.R., 2015, Facile green fabrication of iron-doped cubic ZrO₂ nanoparticles by *Phyllanthus acidus*: Structural, photocatalytic and photoluminescent properties, *J. Mol. Catal. A Chem.*, 397, 36–47.
- Hanaor, D.A.H. dan Sorrell, C.C., 2011, Review of the anatase to rutile phase transformation, *J. Mater. Sci.*, 46, 855–874.
- Ibukun, O. dan Jeong, H.K., 2020, Enhancement of photocatalytic activities of nitrogen-doped titanium dioxide by ambient plasma, *Chem. Phys. Lett.*, 744, 137234.
- Jing, Y., Yin, H., Li, C., Chen, J., Wu, S., Liu, H., Xie, L., Lei, Q., Sun, M. dan Yu, S., 2022, Fabrication of Pt doped TiO₂-ZnO@ZIF-8 core@shell photocatalyst with enhanced activity for phenol degradation, *Environ. Res.*, 203, 111819.
- Karim, S., Pardoyo, P. dan Subagio, A., 2016, Sintesis dan karakterisasi TiO₂ terdoping nitrogen (N-doped TiO₂) dengan metode sol-gel, *J. Kim. Sains dan Apl.*, 19, 63–67.
- Khairy, M. dan Zakaria, W., 2014, Effect of metal-doping of TiO₂ nanoparticles on

- their photocatalytic activities toward removal of organic dyes, *Egypt. J. Pet.*, 23, 419–426.
- Khaki, M.R.D., Shafeeyan, M.S., Raman, A.A.A. dan Daud, W.M.A.W., 2017, Application of doped photocatalysts for organic pollutant degradation - A review, *J. Environ. Manage.*, 198, 78–94.
- Kokporika, L., Onsuratoom, S., Puangpetch, T., dan Chavadej, S., 2013, Sol-gel-synthesized mesoporous-assembled TiO₂-ZrO₂ mixed oxide nanocrystals and their photocatalytic sensitized H₂ production activity under visible light irradiation, *Mater. Sci. Semicond. Process.*, 16, 667–678.
- Kurban, H., Dalkilic, M., Temiz, S. dan Kurban, M., 2020, Tailoring the structural properties and electronic structure of anatase, brookite and rutile phase TiO₂ nanoparticles: DFTB calculations, *Comput. Mater. Sci.*, 183, 109843.
- Kurniawan, R., 2018, Synthesis of iron doped zirconium titanate as potential visible-responsive photocatalyst with various dopant concentrations and calcination temperatures, *Tesis*, Departemen Kimia FMIPA UGM, Yogyakarta.
- Kurniawan, R., Sudiono, S., Trisunaryanti, W., and Syoufian, A., 2019, Synthesis of iron-doped zirconium titanate as a potential visible-light responsive photocatalyst, *Indones. J. Chem.*, 19, 454–460.
- Lal, M., Sharma, P. dan Ram, C., 2021, Calcination temperature effect on titanium oxide (TiO₂) nanoparticles synthesis, *Optik (Stuttg.)*, 241, 166934.
- Lee, H., Jang, H.S., Kim, N.Y. dan Joo, J.B., 2021, Cu-doped TiO₂ hollow nanostructures for the enhanced photocatalysis under visible light conditions, *J. Ind. Eng. Chem.*, 99, 352–363.
- López, R., Gómez, R. dan Llanos, M.E., 2010, Photophysical and photocatalytic properties of nanosized copper-doped titania sol-gel catalysts, *Catal. Today*, 148, 103–108.
- Mathew, S., Ganguly, P., Rhatigan, S., Kumaravel, V., Byrne, C., Hinder, S.J., Bartlett, J., Nolan, M. dan Pillai, S.C., 2018, Cu-doped TiO₂: Visible light assisted photocatalytic antimicrobial activity, *Appl. Sci.*, 8, 1–20.
- Neppolian, B., Wang, Q., Yamashita, H. dan Choi, H., 2007, Synthesis and characterization of ZrO₂-TiO₂ binary oxide semiconductor nanoparticles: Application and interparticle electron transfer process, *Appl. Catal. A Gen.*, 333, 264–271.
- Nolan, N.T., Synnott, D.W., Seery, M.K., Hinder, S.J., Van Wassenhoven, A. dan Pillai, S.C., 2012, Effect of N-doping on the photocatalytic activity of sol-gel TiO₂, *J. Hazard. Mater.*, 211–212, 88–94.

- Nur, A.S.M., Sultana, M., Mondal, A., Islam, S., Robel, F.N., Islam, A. dan Sumi, M.S.A., 2022, A review on the development of elemental and codoped TiO₂ photocatalysts for enhanced dye degradation under UV–vis irradiation, *J. Water Process Eng.*, 47, 102728.
- Ohtani, B., 2010, Photocatalysis A to Z-What we know and what we do not know in a scientific sense, *J. Photochem. Photobiol. C Photochem. Rev.*, 11, 157–178.
- Opra, D.P., Gnedenkov, S. V., Sinebryukhov, S.A., Ustinov, A.Y., Podgorbunsky, A.B. dan Sokolov, A.A., 2019, Effect of isovalent doping by Zr⁴⁺ ions on the electrochemical behavior of TiO₂(B), *Russ. J. Inorg. Chem.*, 64, 680–687.
- Di Paola, A., Bellardita, M. dan Palmisano, L., 2013, Brookite, the least known TiO₂ photocatalyst, *Catalyst*, 3, 36-73.
- Peiris, S., de Silva, H.B., Ranasinghe, K.N., Bandara, S. V. dan Perera, I.R., 2021, Recent development and future prospects of TiO₂ photocatalysis, *J. Chinese Chem. Soc.*, 68, 738–769.
- Pelaez, M., Nolan, N.T., Pillai, S.C., Seery, M.K., Falaras, P., Kontos, A.G., Dunlop, P.S.M., Hamilton, J.W.J., Byrne, J.A., O’Shea, K., Entezari, M.H. dan Dionysiou, D.D., 2012, A review on the visible light active titanium dioxide photocatalysts for environmental applications, *Appl. Catal. B Environ.*, 125, 331–349.
- Pirhashemi, M., Habibi-Yangjeh, A. dan Rahim Pouran, S., 2018, Review on the criteria anticipated for the fabrication of highly efficient ZnO-based visible-light-driven photocatalysts, *J. Ind. Eng. Chem.*, 62, 1–25.
- Polliotto, V., Albanese, E., Livraghi, S., Indyka, P., Sojka, Z., Pacchioni, G. dan Giamello, E., 2017, Fifty-fifty Zr-Ti solid solution with a TiO₂-type structure: Electronic structure and photochemical properties of zirconium titanate ZrTiO₄, *J. Phys. Chem. C*, 121, 5487–5497.
- Polliotto, V., Albanese, E., Livraghi, S., Pacchioni, G. dan Giamello, E., 2017, The photoactive nitrogen impurity in nitrogen-doped zirconium titanate (N-ZrTiO₄): A combined electron paramagnetic resonance and density functional theory study, *J. Mater. Chem. A*, 5, 13062–13071.
- Pramesti, F.D., 2017, Pengaruh jumlah CuCl₂.2H₂O dan suhu kalsinasi terhadap karakter Cu-doped ZrTiO₄ sebagai model fotokatalis responsif sinar tampak, *Tesis*, Departemen Kimia FMIPA UGM, Yogyakarta.
- Preethi, L.K., Antony, R.P., Mathews, T., Walczak, L. dan Gopinath, C.S., 2017, A Study on doped heterojunctions in TiO₂ Nanotubes: An efficient photocatalyst for solar water splitting, *Sci. Rep.*, 7, 1–15.
- Putri, A.Z. dan Ratnawulan, 2019, Analisis teoristik nanopartikel zirkonium dioksida

- (ZrO₂), *Pillar Phys.*, 12, 70–76.
- Qu, X., Song, H., Pan, G., Bai, X., Dong, B., Zhao, H., Dai, Q., Zhang, H., Qin, R. dan Lu, S., 2009, Three-dimensionally ordered macroporous ZrO₂:Eu³⁺: Photonic band effect and local environments, *J. Phys. Chem. C*, 113, 5906–5911.
- Reddy, C.V., Reddy, I.N., Harish, V.V.N., Reddy, K.R., Shetti, N.P., Shim, J. dan Aminabhavi, T.M., 2020, Efficient removal of toxic organic dyes and photoelectrochemical properties of iron-doped zirconia nanoparticles, *Chemosphere*, 239, 124766.
- Samokhvalov, A., 2017, Hydrogen by photocatalysis with nitrogen codoped titanium dioxide, *Renew. Sustain. Energy Rev.*, 72, 981–1000.
- Selvaraj, A., Parimiladevi, R. dan Rajesh, K.B., 2013, Synthesis of nitrogen doped titanium dioxide (TiO₂) and its photocatalytic performance for the degradation of indigo carmine dye, *J. Environ. Nanotechnol.*, 2, 28–31.
- Sengupta, P., Bhattacharjee, A. dan Maiti, H.S., 2019, Zirconia: A unique multifunctional ceramic material, *Trans. Indian Inst. Met.*, 72, 1981–1998.
- Shu, Z., Jiao, X. dan Chen, D., 2013, Hydrothermal synthesis and selective photocatalytic properties of tetragonal star-like ZrO₂ nanostructures, *CrystEngComm*, 15, 4288–4294.
- Sigwadi, R., Dhlamini, M., Mokrani, T. dan Nemavhola, F., 2019, Preparation of a high surface area zirconium oxide for fuel cell application, *Int. J. Mech. Mater. Eng.*, 14, 1–11.
- Sigwadi, R., Mokrani, T. dan Dhlamini, M., 2020, The synthesis, characterization and electrochemical study of zirconia oxide nanoparticles for fuel cell application, *Phys. B Condens. Matter*, 581, 411842.
- Simon, S.M., George, G., M S, S., V P, P., Anna Jose, T., Vasudevan, P., Saritha, A.C., Biju, P.R., Joseph, C. dan Unnikrishnan, N. V., 2021, Recent advancements in multifunctional applications of sol-gel derived polymer incorporated TiO₂-ZrO₂ composite coatings: A comprehensive review, *Appl. Surf. Sci. Adv.*, 6, 100173.
- Someswararao, M. V., Dubey, R.S., Subbarao, P.S.V. dan Singh, S., 2018, Electrospinning process parameters dependent investigation of TiO₂ nanofibers, *Results Phys.*, 11, 223–231.
- Tamarani, A., Zainul, R. dan Dewata, I., 2019, Preparation and characterization of XRD nano Cu-TiO₂ using sol-gel method, *J. Phys. Conf. Ser.*, 1185, 012020.
- Thambiliyagodage, C., 2021, Activity enhanced TiO₂ nanomaterials for photodegradation of dyes - A review, *Environ. Nanotechnology, Monit. Manag.*, 16, 100592.

- Verma, S., Rani, S., Kumar, S. dan Khan, M.A.M., 2018, Rietveld refinement, micro-Structural, optical and thermal parameters of zirconium titanate composites, *Ceram. Int.*, 44, 1653–1661.
- Wang, S., Yang, X.J., Jiang, Q. dan Lian, J.S., 2014, Enhanced optical absorption and photocatalytic activity of Cu/N-codoped TiO₂ nanocrystals, *Mater. Sci. Semicond. Process.*, 24, 247–253.
- Zhang, F., Wang, X., Liu, H., Liu, C., Wan, Y., Long, Y. dan Cai, Z., 2019, Recent advances and applications of semiconductor photocatalytic technology, *Appl. Sci.*, 9, 1–43.