



DAFTAR PUSTAKA

- Aguilar, T., Navas, J., Alcántara, R., Fernández-Lorenzo, C., Gallardo, J.J., Blanco, G., and Martín-Calleja, J., 2013, A route for the synthesis of Cu-doped TiO₂ nanoparticles with a very low band gap, *Chem. Phys. Lett.*, 571, 49–53.
- Ahmed, S.A., 2017, Structural, optical, and magnetic properties of Cu-doped TiO₂ samples, *Cryst. Res. Technol.*, 52, 1600335(1–8).
- Akpan, U.G. and Hameed, B.H., 2010, The advancements in sol-gel method of doped-TiO₂ photocatalysts, *Appl. Catal. A Gen.*, 375, 1–11.
- Allocati, N., Masulli, M., Alexeyev, M.F., and Ilio, C. Di, 2013, *Escherichia coli* in Europe: An Overview, *Int. J. Environ. Res. Public Heal. Public Heal.*, 10, 6235–6254.
- Alotaibi, A.M., Williamson, B.A.D., Sathasivam, S., Kafizas, A., Alqahtani, M., Sotelo-Vazquez, C., Buckeridge, J., Wu, J., Nair, S.P., Scanlon, D.O., and Parkin, I.P., 2020, Enhanced photocatalytic and antibacterial ability of Cu-doped anatase TiO₂ thin films: theory and experiment, *ACS Appl. Mater. Interfaces*, 12, 15348–15361.
- Asahi, R. and Morikawa, T., 2007, Nitrogen complex species and its chemical nature in TiO₂ for visible-light sensitized photocatalysis, *Chem. Phys.*, 339, 57–63.
- Asahi, R., Morikawa, T., Irie, H., and Ohwaki, T., 2014, Nitrogen-doped titanium dioxide as visible-light-sensitive photocatalyst: Designs, developments, and prospects, *Chem. Rev.*, 114, 9824–9852.
- Ateia, M., Alalm, M.G., Awfa, D., Johnson, M.S., and Yoshimura, C., 2020, Modeling the degradation and disinfection of water pollutants by photocatalysts and composites: A critical review, *Sci. Total Environ.*, 698, 134197(1–16).
- Bensouici, F., Bououdina, M., Dakhel, A.A., Tala-Ighil, R., Tounane, M., Iratni, A., Souier, T., Liu, S., and Cai, W., 2017, Optical, structural and photocatalysis properties of Cu-doped TiO₂ thin films, *Appl. Surf. Sci.*, 395, 110–116.
- Bhattacharya, P., Swarnakar, S., Ghosh, S., Majumdar, S., and Banerjee, S., 2019, Disinfection of drinking water via algae mediated green synthesized copper oxide nanoparticles and its toxicity evaluation, *J. Environ. Chem. Eng.*, 7, 102867–102877.
- Chen, S., Li, X., Zhou, W., Zhang, S., and Fang, Y., 2019, Carbon-coated Cu-TiO₂ nanocomposite with enhanced photostability and photocatalytic activity, *Appl. Surf. Sci.*, 466, 254–261.
- Cuerda-Correa, E.M., Alexandre-Franco, M.F., and Fernández-González, C., 2020, Advanced oxidation processes for the removal of antibiotics from water. An



overview, *Water*, 12, 1–51.

Daghrir, R., Drogui, P., and Robert, D., 2013, Modified TiO₂ for environmental photocatalytic applications: A review, *Ind. Eng. Chem. Res.*, 52, 3581–3599.

Dalrymple, O.K., Stefanakos, E., Trotz, M.A., and Goswami, D.Y., 2010, A review of the mechanisms and modeling of photocatalytic disinfection, *Appl. Catal. B Environ.*, 98, 27–38.

Darab, F.A.A. and Ahmadlouydarab, M., 2019, Application of phosphorescent material in activation of N:Cu:TiO₂ photocatalyst as antibacterial and dye removal agent from solid surfaces used in hospitals, *J. Environ. Chem. Eng.*, 7, 102956–102954.

Daraee, M., Ghasemy, E., and Rashidi, A., 2020, Effective adsorption of hydrogen sulfide by intercalation of TiO₂ and N-doped TiO₂ in graphene oxide, 8, 1–10.

Dashora, A., Patel, N., Kothari, D.C., Ahuja, B.L., and Miotello, A., 2014, Formation of an intermediate band in the energy gap of TiO₂ by Cu-N-codoping: First principles study and experimental evidence, *Sol. Energy Mater. Sol. Cells*, 125, 120–126.

Demirel, C.S., Birben, N.C., and Bekbolet, M., 2018, A comprehensive review on the use of second generation TiO₂ photocatalysts: Microorganism inactivation, *Chemosphere*, 211, 420–448.

Dimitrakopoulou, D., Rethemiotaki, I., Frontistis, Z., Xekoukoulotakis, N.P., Venieri, D., and Mantzavinos, D., 2012, Degradation, mineralization and antibiotic inactivation of amoxicillin by UV-A/TiO₂ photocatalysis, *J. Environ. Manage.*, 98, 168–174.

Du, S., Lian, J., and Zhang, F., 2022, Visible Light-Responsive N-Doped TiO₂ Photocatalysis: Synthesis, Characterizations, and Applications, *Trans. Tianjin Univ.*, 28, 33–52.

El-Bahy, Z.M., Ismail, A.A., and Mohamed, R.M., 2009, Enhancement of titania by doping rare earth for photodegradation of organic dye (Direct Blue), *J. Hazard. Mater.*, 166, 138–143.

Elmolla, E.S. and Chaudhuri, M., 2010, Degradation of amoxicillin, ampicillin and cloxacillin antibiotics in aqueous solution by the UV/ZnO photocatalytic process, *J. Hazard. Mater.*, 173, 445–449.

Etacheri, V., Seery, M.K., Hinder, S.J., and Pillai, S.C., 2010, Highly Visible Light Active TiO_{2-x}N_x Heterojunction Photocatalysts, *Chem. Mater.*, 22, 3843–3853.

Etacheri, V., Di Valentin, C., Schneider, J., Bahnemann, D., and Pillai, S.C., 2015, Visible-light activation of TiO₂ photocatalysts: Advances in theory and experiments, *J. Photochem. Photobiol. C Photochem. Rev.*, 25, 1–29.

Fan, C., Xue, P., and Sun, Y., 2006, Preparation of Nano-TiO₂ Doped with Cerium and Its Photocatalytic Activity, *J. Rare Earths*, 24, 309–313.



- Fisher, M.B., Keane, D.A., Fernández-Ibáñez, P., Colreavy, J., Hinder, S.J., McGuigan, K.G., and Pillai, S.C., 2013, Nitrogen and copper doped solar light active TiO₂ photocatalysts for water decontamination, *Appl. Catal. B Environ.*, 130–131, 8–13.
- Fu, F., Chen, R., and Xiong, Y., 2006, Application of a novel strategy-Coordination polymerization precipitation to the treatment of Cu²⁺-containing wastewaters, *Sep. Purif. Technol.*, 52, 388–393.
- Gai, Y., Li, J., Li, S.S., Xia, J.B., and Wei, S.H., 2009, Design of narrow-gap TiO₂: A passivated codoping approach for enhanced photoelectrochemical activity, *Phys. Rev. Lett.*, 102, 23–26.
- Gan, Y., Zhang, M., Xiong, J., Zhu, J., Li, W., Zhang, C., and Cheng, G., 2019, Impact of Cu particles on adsorption and photocatalytic capability of mesoporous Cu@TiO₂ hybrid towards ciprofloxacin antibiotic removal, *J. Taiwan Inst. Chem. Eng.*, 96, 229–242.
- Gao, F., Jiang, J., Du, L., Liu, X., and Ding, Y., 2018, Stable and highly efficient Cu/TiO₂ nanocomposite photocatalyst prepared through atomic layer deposition, *Appl. Catal. A Gen.*, 568, 168–175.
- García-Reiriz, A., Damiani, P.C., and Olivier, A.C., 2007, Different strategies for the direct determination of amoxicillin in human urine by second-order multivariate analysis of kinetic–spectrophotometric data, *Talanta*, 71, 806–815.
- Gomes, J., Lincho, J., Domingues, E., Quinta-Ferreira, R.M., and Martins, R.C., 2019, N-TiO₂ photocatalysts: A review of their characteristics and capacity for emerging contaminants removal, *Water*, 11, 1–35.
- Gonell, F., Puga, A. V., Julián-López, B., García, H., and Corma, A., 2016, Copper-doped titania photocatalysts for simultaneous reduction of CO₂ and production of H₂ from aqueous sulfide, *Appl. Catal. B Environ.*, 180, 263–270.
- Gupta, R. and Modak, J., 2020, Bacterial Lysis via Photocatalysis - A Critical Mechanistic Review, *ChemCatChem*, 12, 2148–2170.
- Hanaor, D.A.H. and Sorrell, C.C., 2011, Review of the anatase to rutile phase transformation, *J. Mater. Sci.*, 46, 855–874.
- Hernández, J.V., Coste, S., García Murillo, A., Romo, F.C., and Kassiba, A., 2017, Effects of metal doping (Cu, Ag, Eu) on the electronic and optical behavior of nanostructured TiO₂, *J. Alloys Compd.*, 710, 355–363.
- Horikoshi, S. and Serpone, N., 2020, Can the photocatalyst TiO₂ be incorporated into a wastewater treatment method? Background and prospects, *Catal. Today*, 340, 334–346.
- Hosseinzadeh, G., Rasoulnezhad, H., Ghasemian, N., and Hosseinzadeh, R., 2019, Ultrasonic-assisted spray pyrolysis technique for synthesis of transparent S-doped TiO₂ thin film, *J. Aust. Ceram. Soc.*, 55, 387–394.



- Hu, N., Liu, W., Jin, L., Li, Y., Li, Z., Liu, G., Huang, D., Wu, Z., and Yin, H., 2017, Recovery of trace Cu²⁺ using a process of nano-adsorption coupled with flotation: SNP as an adsorbing carrier, *Sep. Purif. Technol.*, 184, 257–263.
- Jaiswal, R., Bharambe, J., Patel, N., Dashora, A., Kothari, D.C., and Miotello, A., 2015, Copper and Nitrogen co-doped TiO₂ photocatalyst with enhanced optical absorption and catalytic activity, *Appl. Catal. B Environ.*, 168–169, 333–341.
- Jia, L., Wu, C., Han, S., Yao, N., Li, Y., Li, Z., Chi, B., Pu, J., and Jian, L., 2011, Theoretical study on the electronic and optical properties of (N, Fe)-codoped anatase TiO₂ photocatalyst, *J. Alloys Compd.*, 509, 6067–6071.
- Karthik, K., Pandian, S.K., and Jaya, N.V., 2010, Applied Surface Science Effect of nickel doping on structural , optical and electrical properties of TiO₂ nanoparticles by sol – gel method, *Appl. Surf. Sci.*, 256, 6829–6833.
- Karunakaran, C., Abiramasundari, G., Gomathisankar, P., Manikandan, G., and Anandi, V., 2010, Cu-doped TiO₂ nanoparticles for photocatalytic disinfection of bacteria under visible light, *J. Colloid Interface Sci.*, 352, 68–74.
- Kasprzyk-Hordern, B., Dinsdale, R.M., and Guwy, A.J., 2008, The occurrence of pharmaceuticals, personal care products, endocrine disruptors and illicit drugs in surface water in South Wales, UK, *Water Res.*, 42, 3498–3518.
- Kerkez-Kuyumcu, Ö., Kibar, E., Dayioğlu, K., Gedik, F., Akin, A.N., and Özkaray Aydinoğlu, S., 2015, A comparative study for removal of different dyes over M/TiO₂(M = Cu, Ni, Co, Fe, Mn and Cr) photocatalysts under visible light irradiation, *J. Photochem. Photobiol. A Chem.*, 311, 176–185.
- Kim, C.S., Shin, J.W., Cho, Y.H., Jang, H.D., Byun, H.S., and Kim, T.O., 2013, Synthesis and characterization of Cu/N-doped mesoporous TiO₂ visible light photocatalysts, *Appl. Catal. A Gen.*, 455, 211–218.
- Klauson, D., Babkina, J., Stepanova, K., Krichevskaya, M., and Preis, S., 2010, Aqueous photocatalytic oxidation of amoxicillin, *Catal. Today*, 151, 39–45.
- Kumar, S.G. and Devi, L.G., 2011, Review on modified TiO₂ photocatalysis under UV/visible light: Selected results and related mechanisms on interfacial charge carrier transfer dynamics, *J. Phys. Chem. A*, 115, 13211–13241.
- Lakard, S., Magnenet, C., Mokhter, M.A., Euvrard, M., Buron, C.C., and Lakard, B., 2015, Retention of Cu(II) and Ni(II) ions by filtration through polymer-modified membranes, *Sep. Purif. Technol.*, 149, 1–8.
- Lalliansanga, Tiwari, D., Lee, S.M., and Kim, D.J., 2022, Photocatalytic degradation of amoxicillin and tetracycline by template synthesized nano-structured Ce³⁺@TiO₂ thin film catalyst, *Environ. Res.*, 210, 112914–112925.
- Langford, B.J., So, M., Raybardhan, S., Leung, V., Soucy, J.P.R., Westwood, D., Daneman, N., and MacFadden, D.R., 2021, Antibiotic prescribing in patients with COVID-19: rapid review and meta-analysis, *Clin. Microbiol. Infect.*, 27, 520–531.



- Li, H., Hao, Y., Lu, H., Liang, L., Wang, Yuanyang, Qiu, J., Shi, X., Wang, Ying, and Yao, J., 2015, A systematic study on visible-light N-doped TiO₂ photocatalyst obtained from ethylenediamine by sol-gel method, *Appl. Surf. Sci.*, 344, 112–118.
- Li, N., Wang, B., Si, Y., Xue, F., Zhou, J., Lu, Y., and Liu, M., 2019, Toward high-value hydrocarbon generation by photocatalytic reduction of CO₂ in water vapor, *ACS Catal.*, 9, 5590–5602.
- Li, Q., Kong, H., Li, P., Shao, J., and He, Y., 2019, Photo-Fenton degradation of amoxicillin via magnetic TiO₂-graphene oxide-Fe₃O₄ composite with a submerged magnetic separation membrane photocatalytic reactor (SMSMPR), *J. Hazard. Mater.*, 373, 437–446.
- Liang, J., Wang, J., Song, K., Wang, X., Yu, K., and Liang, C., 2019, Enhanced photocatalytic activities of Nd-doped TiO₂ under visible light using a facile sol-gel method, *J. Rare Earths*, 2–10.
- Limato, R., Lazarus, G., Dernison, P., Mudia, M., Alamanda, M., Nelwan, E.J., Sinto, R., Karuniawati, A., Rogier van Doorn, H., and Hamers, R.L., 2022, Optimizing antibiotic use in Indonesia: A systematic review and evidence synthesis to inform opportunities for intervention, *Lancet Reg. Heal. - Southeast Asia*, 2, 1–23.
- Lin, Y., Jiang, Z., Zhu, C., Hu, X., Zhang, X., Zhu, H., and Fan, J., 2012, Enhanced optical absorption and photocatalytic activity of anatase TiO₂ through (Si,Ni) codoping, *Appl. Phys. Lett.*, 101, 062106–06211.
- Lin, Y.H., Hsueh, H.T., Chang, C.W., and Chu, H., 2016, The visible light-driven photodegradation of dimethyl sulfide on S-doped TiO₂: Characterization, kinetics, and reaction pathways, *Appl. Catal. B Environ.*, 199, 1–10.
- Liu, C., Yua, T., Tan, X., and Huang, X., 2017, Comparison N-Cu-codoped nanotitania and N-doped nanotitania in photocatalytic reduction of CO₂ under UV light, *Inorg. Nano-Metal Chem.*, 47, 9–14.
- Liu, Y., Ye, Z., Li, D., Wang, M., Zhang, Y., and Huang, W., 2019, Tuning CuO_x-TiO₂ interaction and photocatalytic hydrogen production of CuO_x/TiO₂ photocatalysts via TiO₂ morphology engineering, *Appl. Surf. Sci.*, 473, 500–510.
- López, R., Gómez, R., and Llanos, M.E., 2010, Photophysical and photocatalytic properties of nanosized copper-doped titania sol-gel catalysts, *Catal. Today*, 148, 103–108.
- Luo, D., Yan, R., Fu, C., Zhen, Z., Yue, H., Wu, P., and Jiang, W., 2019, Cu(0)/TiO₂ composite byproduct from photo-reduction of acidic Cu-containing wastewater and its reuse as a catalyst, *J. Water Process Eng.*, 32, 100958–100969.
- Lv, T., Zhao, J., Chen, M., Shen, K., Zhang, D., Zhang, J., Zhang, G., and Liu, Q., 2018, Boosted visible-light photodegradation of methylene blue by V and Co



co-doped TiO₂, *Materials (Basel)*., 11, 1946–1958.

- Manikandan, S., Subbaiya, R., Saravanan, M., Ponraj, M., Selvam, M., and Pugazhendhi, A., 2022, A critical review of advanced nanotechnology and hybrid membrane based water recycling, reuse, and wastewater treatment processes, *Chemosphere*, 289, 132867.
- Matos, J., Miralles-Cuevas, S., Ruíz-Delgado, A., Oller, I., and Malato, S., 2017, Development of TiO₂-C photocatalysts for solar treatment of polluted water, *Carbon N. Y.*, 122, 361–373.
- Mhemid, R.K.S., Salman, M.S., and Mohammed, N.A., 2022, Comparing the efficiency of N-doped TiO₂ and commercial TiO₂ as photo catalysts for amoxicillin and ciprofloxacin photodegradation under solar irradiation, *J. Environ. Sci. Heal. - Part A Toxic/Hazardous Subst. Environ. Eng.*, 57, 813–829.
- Moongraksathum, B., Shang, J.Y., and Chen, Y.W., 2018, Photocatalytic antibacterial effectiveness of Cu-doped TiO₂ thin film prepared via the peroxy sol-gel method, *Catalysts*, 8, 351–361.
- Morikawa, T., Irokawa, Y., and Ohwaki, T., 2006, Enhanced photocatalytic activity of TiO_{2-x}N_x loaded with copper ions under visible light irradiation, *Appl. Catal. A Gen.*, 314, 123–127.
- Mustapha, S., Ndamitso, M.M., Abdulkareem, A.S., Tijani, J.O., Shuaib, D.T., Ajala, A.O., and Mohammed, A.K., 2020, Application of TiO₂ and ZnO nanoparticles immobilized on clay in wastewater treatment: a review, *Appl. Water Sci.*, 10, 1–36.
- Natarajan, T.S., Mozhiarasi, V., and Tayade, R.J., 2021, Nitrogen Doped Titanium Dioxide (N-TiO₂): Synopsis of Synthesis Methodologies, Doping Mechanisms, Property Evaluation and Visible Light Photocatalytic Applications, *Photochem 2021, Vol. 1, Pages 371-410*, 1, 371–410.
- Nepel, T.C. de M., Costa, J.M., Gurgel Adeodato Vieira, M., and Almeida Neto, A.F. de, 2020, Copper removal kinetic from electroplating industry wastewater using pulsed electrodeposition technique, *Environ. Technol.*, 43, 469–477.
- Nolan, N.T., Synnott, D.W., Seery, M.K., Hinder, S.J., Van Wassenhoven, A., and Pillai, S.C., 2012, Effect of N-doping on the photocatalytic activity of sol-gel TiO₂, *J. Hazard. Mater.*, 211–212, 88–94.
- Nosaka, Y. and Nosaka, A., 2016, Understanding Hydroxyl Radical (\bullet OH) Generation Processes in Photocatalysis, *ACS Energy Lett.*, 1, 356–359.
- Odling, G. and Robertson, N., 2015, Why is anatase a better photocatalyst than rutile? the importance of free hydroxyl radicals, *ChemSusChem*, 8, 1838–1840.
- Ojemaye, M.O., Okoh, O.O., and Okoh, A.I., 2017, Adsorption of Cu²⁺ from aqueous solution by a novel material; azomethine functionalized magnetic nanoparticles, Elsevier B.V.



- Padil, V.V.T. and Černík, M., 2013, Green synthesis of copper oxide nanoparticles using gum karaya as a biotemplate and their antibacterial application, *Int. J. Nanomedicine*, 8, 889–898.
- Padmanabhan, S.C., Pillai, S.C., Colreavy, J., Balakrishnan, S., McCormack, D.E., Perova, T.S., Gun'ko, Y., Hinder, S.J., and Kelly, J.M., 2007, A Simple Sol—Gel Processing for the Development of High-Temperature Stable Photoactive Anatase Titania., *ChemInform*, 38, 4474–4481.
- Pal, A., Pehkonen, S.O., Yu, L.E., and Ray, M.B., 2007, Photocatalytic inactivation of Gram-positive and Gram-negative bacteria using fluorescent light, *J. Photochem. Photobiol. A Chem.*, 186, 335–341.
- Parathon, H., Kuntaman, K., Widiastoety, T.H., Muliawan, B.T., Karuniawati, A., Qibtiyah, M., Djanun, Z., Tawilah, J.F., Aditama, T., Thamlikitkul, V., and Vong, S., 2017, Progress towards antimicrobial resistance containment and control in Indonesia, *BMJ*, 358, 31–35.
- Patel, N., Jaiswal, R., Warang, T., Scarduelli, G., Dashora, A., Ahuja, B.L., Kothari, D.C., and Miotello, A., 2014, Efficient photocatalytic degradation of organic water pollutants using V-N-codoped TiO₂ thin films, *Appl. Catal. B Environ.*, 150–151, 74–81.
- Payan, A., Akbar Isari, A., and Gholizade, N., 2019, Catalytic decomposition of sulfamethazine antibiotic and pharmaceutical wastewater using Cu-TiO₂@functionalized SWCNT ternary porous nanocomposite: Influential factors, mechanism, and pathway studies, *Chem. Eng. J.*, 361, 1121–1141.
- Pedroza-Herrera, G., Medina-Ramírez, I.E., Lozano-Álvarez, J.A., and Rodil, S.E., 2020, Evaluation of the photocatalytic activity of copper doped TiO₂ nanoparticles for the purification and/or disinfection of industrial effluents, *Catal. Today*, 341, 37–48.
- 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., and Dionysiou, D.D., 2012, A review on the visible light active titanium dioxide photocatalysts for environmental applications, *Appl. Catal. B Environ.*, 125, 331–349.
- Percival, S.L. and Williams, D.W., 2014, Escherichia coli, *Microbiol. Waterborne Dis. Microbiol. Asp. Risks Second Ed.*, 89–117.
- Pino-Sandoval, D., Rodríguez, M.V.-, Cantú-Cárdenas, M.E., and Hernández-Ramírez, A., 2020, Performance of Ag-Cu/TiO₂ photocatalyst prepared by sol-gel method on the inactivation of Escherichia coli and Salmonella typhimurium, *J. Environ. Chem. Eng.*, 8, 104539–104549.
- Pongwan, P., Wetchakun, K., Phanichphant, S., and Wetchakun, N., 2016, Enhancement of visible-light photocatalytic activity of Cu-doped TiO₂ nanoparticles, *Res. Chem. Intermed.*, 42, 2815–2830.
- Reda, S.M., Khairy, M., and Mousa, M.A., 2020, Photocatalytic activity of nitrogen



and copper doped TiO₂ nanoparticles prepared by microwave-assisted sol-gel process, *Arab. J. Chem.*, 13, 86–95.

Reddy, P.V.L., Kavitha, B., Reddy, P.A.K., and Kim, K.H., 2017, TiO₂-based photocatalytic disinfection of microbes in aqueous media: A review, *Environ. Res.*, 154, 296–303.

Reddy, P.V.L., Kim, K.H., Kavitha, B., Kumar, V., Raza, N., and Kalagara, S., 2018, Photocatalytic degradation of bisphenol A in aqueous media: A review, *J. Environ. Manage.*, 213, 189–205.

Rodríguez-González, V., Obregón, S., Patrón-Soberano, O.A., Terashima, C., and Fujishima, A., 2020, An approach to the photocatalytic mechanism in the TiO₂-nanomaterials microorganism interface for the control of infectious processes, *Appl. Catal. B Environ.*, 270, 118853–118864.

Rudnicki, P., Hubicki, Z., and Kołodyńska, D., 2014, Evaluation of heavy metal ions removal from acidic waste water streams, *Chem. Eng. J.*, 252, 362–373.

Rusinque, B., Escobedo Salas, S., and de Lasa, H., 2020, Photoreduction of a Pd-doped mesoporous TiO₂ photocatalyst for hydrogen production under visible light, *Catalysts*, 10, 74–98.

Salehi, M., 2022, Global water shortage and potable water safety; Today's concern and tomorrow's crisis, *Environ. Int.*, 158, 106936.

Salimi, M., Behbahani, M., Sobhi, H.R., Gholami, M., Jonidi Jafari, A., Rezaei Kalantary, R., Farzadkia, M., and Esrafilo, A., 2019, A new nano-photocatalyst based on Pt and Bi co-doped TiO₂ for efficient visible-light photo degradation of amoxicillin, *New J. Chem.*, 43, 1562–1568.

Salmanvandi, H., Rezaei, P., and Tamsilian, Y., 2020, Photoreduction and Removal of Cadmium Ions over Bentonite Clay-Supported Zinc Oxide Microcubes in an Aqueous Solution, *ACS Omega*, 5, 13176–13184.

Saravanan, A., Deivayanai, V.C., Kumar, P.S., Rangasamy, G., Hemavathy, R. V., Harshana, T., Gayathri, N., and Alagumalai, K., 2022, A detailed review on advanced oxidation process in treatment of wastewater: Mechanism, challenges and future outlook, *Chemosphere*, 308, 136524–136535.

Satyro, S., Marotta, R., Clarizia, L., Di Somma, I., Vitiello, G., Dezotti, M., Pinto, G., Dantas, R.F., and Andreozzi, R., 2014, Removal of EDDS and copper from waters by TiO₂ photocatalysis under simulated UV-solar conditions, *Chem. Eng. J.*, 251, 257–268.

Schneider, J., Matsuoka, M., Takeuchi, M., Zhang, J., Horiuchi, Y., Anpo, M., and Bahnemann, D.W., 2014, Understanding TiO₂ photocatalysis: Mechanisms and materials, *Chem. Rev.*, 114, 9919–9986.

Schreiber, F. and Szewzyk, U., 2008, Environmentally relevant concentrations of pharmaceuticals influence the initial adhesion of bacteria, *Aquat. Toxicol.*, 87, 227–233.



- Shao, G., 2009, Red Shift in Manganese- and Iron-Doped TiO₂: A DFT + U Analysis Red Shift in Manganese- and Iron-Doped TiO₂: A DFT + U Analysis, 113, 6800–6808.
- Shi, J. wen, Zheng, J. tang, and Wu, P., 2009, Preparation, characterization and photocatalytic activities of holmium-doped titanium dioxide nanoparticles, *J. Hazard. Mater.*, 161, 416–422.
- Song, K., Zhou, J., Bao, J., and Feng, Y., 2008, Photocatalytic activity of (copper, nitrogen)-codoped titanium dioxide nanoparticles, *J. Am. Ceram. Soc.*, 91, 1369–1371.
- Štengl, V., Bakardjieva, S., and Murafa, N., 2009, Preparation and photocatalytic activity of rare earth doped TiO₂ nanoparticles, *Mater. Chem. Phys.*, 114, 217–226.
- Taylor, A.A., Tsuji, J.S., Garry, M.R., McArdle, M.E., Goodfellow, W.L., Adams, W.J., and Menzie, C.A., 2020, Critical Review of Exposure and Effects: Implications for Setting Regulatory Health Criteria for Ingested Copper, *Environ. Manage.*, 65, 131–159.
- Tichapondwa, S.M., Newman, J.P., and Kubheka, O., 2020, Effect of TiO₂ phase on the photocatalytic degradation of methylene blue dye, *Phys. Chem. Earth, Parts A/B/C*, 118–119, 102900–102906.
- Trublet, M., Maslova, M. V., Rusanova, D., and Antzutkin, O.N., 2017, Sorption performances of TiO(OH)(H₂PO₄)·H₂O in synthetic and mine waters, *RSC Adv.*, 7, 1989–2001.
- Valentin, D.C., Finazzi, E., Pacchioni, G., Selloni, A., Livraghi, S., Paganini, M.C., and Giamello, E., 2007, N-doped TiO₂ Theory and experiment, *Chem. Phys.*, 339, 44–56.
- Valero, J.M., Obregón, S., and Colón, G., 2014, Active site considerations on the photocatalytic H₂ evolution performance of Cu-Doped TiO₂ obtained by different doping methods, *ACS Catal.*, 4, 3320–3329.
- Verma, M. and Haritash, A.K., 2020, Photocatalytic degradation of Amoxicillin in pharmaceutical wastewater: A potential tool to manage residual antibiotics, *Environ. Technol. Innov.*, 20, 101072–101081.
- Wahyuni, E.T., Yulikayani, P.Y., and Aprilita, N.H., 2020, Enhancement of visible-light photocatalytic activity of Cu-doped TiO₂ for photodegradation of amoxicillin in water, *J. Mater. Environ. Sci.*, 11, 670–683.
- Wang, H., Yang, X., Xiong, W., and Zhang, Z., 2015, Photocatalytic reduction of nitroarenes to azo compounds over N-doped TiO₂: Relationship between catalysts and chemical reactivity, *Res. Chem. Intermed.*, 41, 3981–3997.
- Wang, J. and Zhuan, R., 2020, Degradation of antibiotics by advanced oxidation processes: An overview, *Sci. Total Environ.*, 701, 135023–135038.
- Wang, S., Yang, X.J., Jiang, Q., and Lian, J.S., 2014, Enhanced optical absorption



and photocatalytic activity of Cu/N-codoped TiO₂ nanocrystals, *Mater. Sci. Semicond. Process.*, 24, 247–253.

- Wang, T., Wang, Q., Soklun, H., Qu, G., Xia, T., Guo, X., Jia, H., and Zhu, L., 2019, A green strategy for simultaneous Cu(II)-EDTA decomplexation and Cu precipitation from water by bicarbonate-activated hydrogen peroxide/chemical precipitation, *Chem. Eng. J.*, 370, 1298–1309.
- Wenderich, K. and Mul, G., 2016, Methods, Mechanism, and Applications of Photodeposition in Photocatalysis: A Review, *Chem. Rev.*, 116, 14587–14619.
- Xing, X., Du, Z., Zhuang, J., and Wang, D., 2018, Removal of ciprofloxacin from water by nitrogen doped TiO₂ immobilized on glass spheres: Rapid screening of degradation products, *J. Photochem. Photobiol. A Chem.*, 359, 23–32.
- Xu, S., Ng, J., Zhang, X., Bai, H., and Sun, D.D., 2010, Fabrication and comparison of highly efficient Cu incorporated TiO₂ photocatalyst for hydrogen generation from water, *Int. J. Hydrogen Energy*, 35, 5254–5261.
- Yamanaka, K., Ohwaki, T., and Morikawa, T., 2013, Charge-Carrier Dynamics in Cu- or Fe-Loaded Nitrogen-Doped TiO₂ Powder Studied by Femtosecond Diffuse Reflectance Spectroscopy, *J. Phys. Chem. C*, 117, 16448–16456.
- Yan, R., Luo, D., Fu, C., Tian, W., Wu, P., Wang, Y., Zhang, H., and Jiang, W., 2020, Simultaneous Removal of Cu(II) and Cr(VI) Ions from Wastewater by Photoreduction with TiO₂–ZrO₂, *J. Water Process Eng.*, 33, 101052–101063.
- Yao, X., Wang, X., Su, L., Yan, H., and Yao, M., 2011, Band structure and photocatalytic properties of N/Zr co-doped anatase TiO₂ from first-principles study, *J. Mol. Catal. A Chem.*, 351, 11–16.
- Yeber, M.C., Soto, C., Riveros, R., Navarrete, J., and Vidal, G., 2009, Optimization by factorial design of copper (II) and toxicity removal using a photocatalytic process with TiO₂ as semiconductor, *Chem. Eng. J.*, 152, 14–19.
- Yılmaz, H.Ç., Akgeyik, E., Bougarrani, S., El Azzouzi, M., and Erdemoğlu, S., 2020, Photocatalytic degradation of amoxicillin using Co-doped TiO₂ synthesized by reflux method and monitoring of degradation products by LC–MS/MS, *J. Dispers. Sci. Technol.*, 41, 414–425.
- Yu, Z. and Chuang, S.S.C., 2008, The effect of Pt on the photocatalytic degradation pathway of methylene blue over TiO₂ under ambient conditions, *Appl. Catal. B Environ.*, 83, 277–285.
- Zhang, S., 2012, Synergistic effects of C-Cr codoping in TiO₂ and enhanced sonocatalytic activity under ultrasonic irradiation, *Ultrason. Sonochem.*, 19, 767–771.
- Zhao, W., Liu, S., Zhang, S., Wang, R., and Wang, K., 2019, Preparation and visible-light photocatalytic activity of N-doped TiO₂ by plasma-assisted sol-gel method, *Catal. Today*, 337, 37–43.
- Zhao, Z. and Omer, A.A., 2019, Cu/N-codoped TiO₂ prepared by the sol-gel



method for phenanthrene removal under visible light irradiation, *Environ. Sci. Pollut. Res.*, 27, 17530–17540.

Zhu, D. and Zhou, Q., 2019, Action and mechanism of semiconductor photocatalysis on degradation of organic pollutants in water treatment: A review, *Environ. Nanotechnology, Monit. Manag.*, 12, 100255–100266.

Zhu, S., Wang, Z., Lin, X., Sun, T., Qu, Z., Chen, Y., Su, T., and Huo, Y., 2020, Effective recycling of Cu from electroplating wastewater effluent via the combined Fenton oxidation and hydrometallurgy route, *J. Environ. Manage.*, 271, 110963.

Zhu, W., Qiu, X., Iancu, V., Chen, X.Q., Pan, H., Wang, W., Dimitrijevic, N.M., Rajh, T., Meyer, H.M., Paranthaman, M.P., Stocks, G.M., Weitering, H.H., Gu, B., Eres, G., and Zhang, Z., 2009, Band gap narrowing of titanium oxide semiconductors by noncompensated anion-Cation codoping for enhanced visible-Light photoactivity, *Phys. Rev. Lett.*, 103, 1–4.