

DAFTAR PUSTAKA

- Ahmad, K., Ghatak, H.R. and Ahuja, S.M., 2020, A review on photocatalytic remediation of environmental pollutants and H₂ production through water splitting: A sustainable approach, *Environ. Technol. Innov.*, 19, 100893.
- Ahmed, W. and Iqbal, J., 2020, Co doped ZrO₂ nanoparticles: An efficient visible light triggered photocatalyst with enhanced structural, optical and dielectric characteristics, *Ceram. Int.*, 46, 25833–25844.
- Allen, N.S., Mahdjoub, N., Vishnyakov, V., Kelly, P.J. and Kriek, R.J., 2018, The effect of crystalline phase (anatase, brookite and rutile) and size on the photocatalytic activity of calcined polymorphic titanium dioxide (TiO₂), *Polym. Degrad. Stab.*, 150, 31–36.
- 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.
- Aware, D. V. and Jadhav, S.S., 2016, Synthesis, characterization and photocatalytic applications of Zn-doped TiO₂ nanoparticles by sol-gel method, *Appl. Nanosci.*, 6, 965–972.
- Behera, M., Nayak, J., Banarjee, S., Chakraborty, S., and Tripathy S.K., 2021, A review on the treatment of textile industry waste effluents towards the development of efficient mitigation strategy: An integrated system design approach, *J. Environ. Chem. Eng.*, 9 (4), 105277.
- Barkul, R.P., Koli, V.B., Shewale, V.B., Patil, M.K., and Delekar, S.D., 2016, Visible active nanocrystalline N-doped anatase TiO₂ particles for photocatalytic mineralization studies, *Mater. Chem. Phys.*, 173, 42–51.
- Bartholomew, C.H., 2001, Mechanisms of catalyst deactivation, *Appl. Catal. A Gen.*, 212, 17–60.
- Basavarajappa, P.S., Patil, S.B., Ganganagappa, N., Raghava, K., Raghu, A. V and Venkata, C., 2019, Recent progress in metal-doped TiO₂, non-metal doped/codoped TiO₂ and TiO₂ nanostructured hybrids for enhanced photocatalysis, *Int. J. Hydrog. Energi*, 5.
- Chang, S.M. and Doong, R.A., 2006, Characterization of Zr-doped TiO₂ nanocrystals prepared by a nonhydrolytic sol-gel method at high temperatures, *J. Phys. Chem. B.*, 110, 20808–20814.
- Cheng, H.H., Chen, S.S., Yang, S.Y., Liu, H.M. and Lin, K.S., 2018, Sol-Gel hydrothermal synthesis and visible light photocatalytic degradation performance of Fe/N codoped TiO₂ catalysts, *Materials (Basel)*, 11.
- Cong, Y., Zhang, J., Chen, F. and Anpo, M., 2007, Synthesis and characterization

- ,of nitrogen-doped TiO₂ nanophotocatalyst with high visible light activity, *J. Phys. Chem. C.*, 111, 6976–6982.
- Costacurta, S., Maso, G.D., Gallo, R., Guglielmi, M., Brusatin, G. and Falcaro, P., 2010, Influence of temperature on the photocatalytic activity of sol-gel TiO₂ films, *ACS Appl. Mater. Interfaces*, 2, 1294–1298.
- Daghrrir, R., Drogui, P. and Robert, D., 2013, Modified TiO₂ for environmental photocatalytic applications: A review, *Ind. Eng. Chem. Res.*, 52, 3581–3599.
- de Moraes, N.P., de Azeredo, C.A.S.H., Bacetto, L.A., da Silva, M.L.C.P., and Rodrigues, L.A., 2018, The effect of C-doping on the properties and photocatalytic activity of ZrO₂ prepared via sol-gel route, *Optik (Stuttg.)*, 165, 302–309.
- Doufar, N., Benamira, M., Lahmar, H., Trari, M., Avramova, I. and Caldes, M.T., 2020, Structural and photochemical properties of Fe-doped ZrO₂ and their application as photocatalysts with TiO₂ for chromate reduction, *J. Photochem. Photobiol. A Chem.*, 386, 112105.
- Fan, X., Fan, J., Hu, X., Liu, E., Kang, L., Tang, C., Ma, Y., Wu, H. and Li, Y., 2014, Preparation and characterization of Ag deposited and Fe doped TiO₂ nanotube arrays for photocatalytic hydrogen production by water splitting., *Ceram. Int.*, 40, 15907–15917.
- Fang, W., Xing, M. and Zhang, J., 2017, Modifications on reduced titanium dioxide photocatalysts: A review, *J. Photochem. Photobiol. C Photochem. Rev.*, 32, 21–39.
- Gurushantha, K., Anantharaju, K.S., Nagabhushana, H., Sharma, S.C., Vidya, Y.S., Shivakumara, C., Nagaswarupa, H.P., Prashantha, S.C. and 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.
- Haidry, A.A., Puskelova, J., Plecenik, T., Durina, P., Gregus, J., Truchly, M., Roch, T., Zahoran, M., Vargova, M., Kus, P., Plecenik, A. and Plesch, G., 2012, Characterization and hydrogen gas sensing properties of TiO₂ thin films prepared by sol-gel method, *Appl. Surf. Sci.*, 259, 270–275.
- Hamadani, M., Reisi-Vanani, A., Behpour, M. and Esmaeily, A.S., 2011, Synthesis and characterization of Fe,S-codoped TiO₂ nanoparticles: Application in degradation of organic water pollutants, *Desalination*, 281, 319–324.
- Han, Y. and Zhu, J., 2013, Surface Science Studies on the Zirconia-Based Model Surface Science Studies on the Zirconia-Based Model Catalysts, *Top. Catal.*, 56, 1525-1541.
- Horti, N.C., Kamatagi, M.D., Nataraj, S.K., Wari, M.N. and Inamdar, S.R., 2020, Structural and optical properties of zirconium oxide (ZrO₂) nanoparticles:

- effect of calcination temperature, *Nano Express*, 1, 010022.
- Hsu, C.H. and Lin, S.Y., 2013, Characterization of ZrTiO₄ thin films prepared by sol-gel method, *Mater. Sci. Semicond. Process.*, 16, 1262–1266.
- Hu, S., Li, F., Fan, Z. and Chang, C.C., 2011, Enhanced photocatalytic activity and stability of nano-scaled TiO₂ co-doped with N and Fe, *Appl. Surf. Sci.*, 258, 182–188.
- Ihara, T., Miyoshi, M., Ando, M., Sugihara, S. and Iriyama, Y., 2001, Preparation of a visible-light-active TiO₂ photocatalyst by RF plasma treatment, *J. Mater. Sci.*, 36, 4201–4207.
- 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.
- Kalantari, K., Kalbasi, M., Sohrabi, Md. and Royaei, S.J., 2017, Enhancing the photocatalytic oxidation of dibenzothiophene using visible light responsive Fe and N co-doped TiO₂ nanoparticles, *Ceram. Int.*, 43, 973–981.
- Khakpash, N., Simchi, A. and Jafari, T., 2012, Adsorption and solar light activity of transition-metal doped TiO₂ nanoparticles as semiconductor photocatalyst, *J. Mater. Sci. Mater. Electron.*, 23, 659–667.
- Khan, H. and Swati, I.K., 2016, Fe³⁺-doped Anatase TiO₂ with d-d Transition, Oxygen Vacancies and Ti³⁺ Centers: Synthesis, Characterization, UV-vis Photocatalytic and Mechanistic Studies, *Ind. Eng. Chem. Res.*, 55, 6619–6633.
- Khan, S., Kim, J., Sotto, A. and Van der Bruggen, B., 2015, Humic acid fouling in a submerged photocatalytic membrane reactor with binary TiO₂-ZrO₂ particles, *J. Ind. Eng. Chem.*, 21, 779–786.
- Kim, J.Y., Kim, C.S., Chang, H.K. and Kim, T.O., 2010, Effects of ZrO₂ addition on phase stability and photocatalytic activity of ZrO₂/TiO₂ nanoparticles, *Adv. Powder Technol.*, 21, 141–144.
- Komaraiah, D., Radha, E., Kalarikkal, N., Sivakumar, J., Ramana Reddy, M. V. and Sayanna, R., 2019, Structural, optical and photoluminescence studies of sol-gel synthesized pure and iron doped TiO₂ photocatalysts, *Ceram. Int.*, 45, 25060–25068.
- Kumar, S., Bhunia, S. and Ojha, A.K., 2015, Effect of calcination temperature on phase transformation, structural and optical properties of sol-gel derived ZrO₂ nanostructures, *Phys. E Low-Dimensional Syst. Nanostructures*, 66, 74–80.
- 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.

- Lai, C.W., Juan, J.C., Ko, W.B. and Bee Abd Hamid, S., 2014, An overview: Recent development of titanium oxide nanotubes as photocatalyst for dye degradation, *Int. J. Photoenergy*, 2014.
- Lal, M., Sharma, P. and Ram, C., 2021, Calcination temperature effect on titanium oxide (TiO₂) nanoparticles synthesis, *Optik (Stuttg.)*, 241.
- Li, P., Wang, J., Peng, T., Wang, Y., Liang, J., Pan, D. and Fan, Q., 2019, Heterostructure of anatase-rutile aggregates boosting the photoreduction of U(VI), *Appl. Surf. Sci.*, 483, 670–676.
- Li, Z., Liu, S., Du, M., Wang, J., Srivastava, G.P., Wang, M., Wei, T., Zou, Y., Xiao, N. and Zhou, Q., 2021, Journal of Physics and Chemistry of Solids Study of synthesis and photocatalytic performance of the monoclinic/ cubic heterophase junction of rare earth doped zirconia, *J. Phys. Chem. Solids*, 159, 110286.
- Lin, C., Zhang, C. and Lin, J., 2007, Phase transformation and photoluminescence properties of nanocrystalline ZrO₂ powders prepared via the pechini-type sol-gel process, *J. Phys. Chem. C*, 111, 3300–3307.
- Liu, B., Zhao, X., Terashima, C., Fujishima, A. and Nakata, K., 2014, Thermodynamic and kinetic analysis of heterogeneous photocatalysis for semiconductor systems, *Phys. Chem. Chem. Phys.*, 16, 8751–8760.
- Luo, S., Yan, B. and Shen, J., 2017, Enhanced photoelectric property of Mo-C codoped TiO₂ films deposited by RF magnetron cosputtering, *J. Wuhan Univ. Technol. Mater. Sci. Ed.*, 32, 223–228.
- Mahy, J.G., Lejeune, L., Haynes, T., Lambert, D., Henrique, R., Marcilli, M., Fustin, C. and Hermans, S., 2021, Synthesis: The Peptization Method to Obtain Crystalline and Photoactive Materials at Low Temperature, *Catalysts*, 11, 768.
- Malengreux, C.M., Douven, S., Poelman, D., Heinrichs, B. and Bartlett, J.R., 2014, An ambient temperature aqueous sol-gel processing of efficient nanocrystalline doped TiO₂-based photocatalysts for the degradation of organic pollutants, *J. Sol-Gel Sci. Technol.*, 71, 557–570.
- Mancuso, A., Sacco, O., Sannino, D., Pragliola, S. and Vaiano, V., 2020, Enhanced visible-light-driven photodegradation of Acid Orange 7 azo dye in aqueous solution using Fe-N co-doped TiO₂, *Arab. J. Chem.*, 13, 8347–8360.
- Mancuso, A., Sacco, O., Vaiano, V., Bonelli, B., Esposito, S., Freyria, F.S., Blangetti, N. and Sannino, D., 2021, Fe-Doped TiO₂ Prepared by a Three-Block Copolymer Templating Approach, *Materials*, 14, 3105.
- Meetei, S.D. and Singh, S.D., 2014, Hydrothermal synthesis and white light emission of cubic ZrO₂: Eu³⁺ nanocrystals, *J. Alloys Compd.*, 587, 143–147.
- Nasirian, M. and Mehrvar, M., 2018, Photocatalytic degradation of aqueous

- Methyl Orange using nitrogen-doped TiO₂ photocatalyst prepared by novel method of ultraviolet-assisted thermal synthesis, *J. Environ. Sci. (China)*, 66, 81–93.
- Polisetti, S., Deshpande, P.A. and Madras, G., 2011, Photocatalytic activity of combustion synthesized ZrO₂ and ZrO₂-TiO₂ mixed oxides, *Ind. Eng. Chem. Res.*, 50, 12915–12924.
- Qian, R., Zong, H., Schneider, J., Zhou, G., Zhao, T., Li, Y., Yang, J., Bahnemann, D.W. and Pan, J.H., 2019, Charge carrier trapping, recombination and transfer during TiO₂ photocatalysis: An overview, *Catal. Today*, 335, 78–90.
- Ramamoorthy, S., Das, S., Balan, R. and Lekshmi, I.C., 2021, TiO₂-ZrO₂ nanocomposite with tetragonal zirconia phase and photocatalytic degradation of Alizarin Yellow GG azo dye under natural sunlight, *Mater. Today Proc.*, 2021.
- Ravindra, N.M., Ganapathy, P. and Choi, J., 2018, Energy gap-refractive index relations in semiconductors - An overview, *Infrared Phys. Technol.*, 50, 21–29.
- Shen, J.H., Tang, Y.H., Jiang, Z.W., Liao, D.Q. and Horng, J.J., 2021, Optimized preparation and characterization of Co-N codoped TiO₂ with enhanced visible light activity: An insight into effect of dopants on surface redox reactions of photogenerated charge carriers for hydroxyl radical formation, *J. Alloys Compd.*, 862, 158697.
- Shinde, S.G., Patil, M.P., Kim, G. D. and Shrivastava, V.S., 2020, Ni, C, N, S multi-doped ZrO₂ decorated on multi-walled carbon nanotubes for effective solar induced degradation of anionic dye, *J. Environ. Chem. Eng.*, 8, 103769.
- Shutilov, A.A., Zenkovets, G.A., 2019, Design of new nanostructured thermostable TiO₂ of anatase structure doped with alumina, *Mater. Today Proc.*, 12, 142–146.
- Sohlberg, K., Nie, X., Zhuo, S. and Maeng, G., 2009, Doping of TiO₂ polymorphs for altered optical and photocatalytic properties, *Int. J. Photoenergy*, 2009.
- Sood, S., Umar, A., Mehta, S.K. and Kansal, S.K., 2015, Highly effective Fe-doped TiO₂ nanoparticles photocatalysts for visible-light driven photocatalytic degradation of toxic organic compounds, *J. Colloid Interface Sci.*, 450, 213–223.
- Su, C., Hong, B., and Tseng, C., 2004, Sol – gel preparation and photocatalysis of titanium dioxide, 96, 119–126.
- Sulaiman, S.N.A., Zaky Noh, M., Nadia Adnan, N., Bidin, N., and Ab Razak, S.N., 2018, Effects of photocatalytic activity of metal and non-metal doped TiO₂ for Hydrogen production enhancement - A Review, *J. Phys. Conf. Ser.*,

1027.

- Suwannaruang, T., Hildebrand, J.P., Taffa, D.H., Wark, M., Kamonsuangkasem, K., Chirawatkul, P. and Wantala, K., 2020, Visible light-induced degradation of antibiotic ciprofloxacin over Fe–N–TiO₂ mesoporous photocatalyst with anatase/rutile/brookite nanocrystal mixture, *J. Photochem. Photobiol. A Chem.*, 391,
- Suwannaruang, T., Kamonsuangkasem, K., Kidkhunthod, P., Chirawatkul, P., Saiyasombat, C., Chanlek, N. and Wantala, K., 2018, Influence of nitrogen content levels on structural properties and photocatalytic activities of nanorice-like N-doped TiO₂ with various calcination temperatures, *Mater. Res. Bull.*, 105, 265–276.
- Tian, F., Wu, Zhansheng, Tong, Y., Wu, Zhilin and Cravotto, G., 2015, Microwave-Assisted Synthesis of Carbon-Based (N,Fe) -Codoped TiO₂ for the Photocatalytic Degradation of Formaldehyde, *Nanoscale Res. Lett.*, 10, 360.
- Tian, G., Pan, K., Fu, H., Jing, L., and Zhou, W., 2009, Enhanced photocatalytic activity of S-doped TiO₂ – ZrO₂ nanoparticles under visible-light irradiation, *J. Hazard. Mater.*, 166, 939–944.
- Wan, H., Yao, W., Zhu, W., Tang, Y., Ge, H., Shi, X. and Duan, T., 2018, Fe-N co-doped SiO₂@TiO₂ yolk-shell hollow nanospheres with enhanced visible light photocatalytic degradation, *Appl. Surf. Sci.*, 444, 355–363.
- Wang, J., Yu, Y., Li, S., Guo, L., Wang, E. and Cao, Y., 2013, Doping behavior of Zr⁴⁺ ions in Zr⁴⁺-doped TiO₂ nanoparticles, *J. Phys. Chem. C*, 117, 27120–27126.
- Yuan, Y., Ruan L., Barber, J., Loo, S. C. J. and Xue, C., 2014, Hetero-Nanostructured Suspended Photocatalysts for Solar-to-Fuel Conversion, *Energy Environ. Sci.*, 7, 3934-3951.
- Zhang, F., Wang, X., Liu, H., Liu, C., Wan, Y., Long, Y. and Cai, Z., 2019, Recent advances and applications of semiconductor photocatalytic technology, *Appl. Sci.*, 9.
- Zhang, J., Zhou, P., Liu, J., and Yu, J., 2014, New understanding of the difference of photocatalytic activity among anatase, rutile and brookite TiO₂, *Phys. Chem. Chem. Phys.*, 16, 20382–20386.
- Zhang, Y. and Li, Q., 2013, Synthesis and characterization of Fe-doped TiO₂ films by electrophoretic method and its photocatalytic activity toward methyl orange, *Solid State Sci.*, 16, 16–20.
- Zhao, Z. and Liu, Q., 2008, Designed highly effective photocatalyst of anatase TiO₂ codoped with nitrogen and vanadium under visible-light irradiation using first-principles, *Catal. Letters*, 124, 111–117.

- Zheng, J., Sun, L., Jiao, C., Shao, Q., Lin, J., Pan, D., Naik, N. and Guo, Z., 2021, Hydrothermally synthesized Ti/Zr bimetallic MOFs derived N self-doped TiO₂/ZrO₂ composite catalysts with enhanced photocatalytic degradation of methylene blue, *Colloids Surfaces A Physicochem. Eng. Asp.*, 623, 126629.
- Zhu, D. and Zhou, Q., 2019, Action and mechanism of semiconductor photocatalysis on degradation of organic pollutants in water treatment: A review, *Environ. Nanotechnol. Monit. Manag.*, 12, 100255