

DAFTAR PUSTAKA

- Abu Elella, M. H., Goda, E. S., Gamal, H., El-Bahy, S. M., Nour, M. A., & Yoon, K. R. (2021). Green antimicrobial adsorbent containing grafted xanthan gum/SiO₂ nanocomposites for malachite green dye. *International Journal of Biological Macromolecules*, 191, 385–395. <https://doi.org/10.1016/j.ijbiomac.2021.09.040>
- Agustina, T. E., Melwita, E., Bahrin, D., Gayatri, R., & Purwaningtyas, I. F. (2020). Synthesis of Nano-Photocatalyst ZnO-Natural Zeolite to Degrade Procion Red. *International Journal of Technology*, 11(3), 472. <https://doi.org/10.14716/ijtech.v11i3.3800>
- Ahmed, M. A., & Mohamed, A. A. (2023). Recent progress in semiconductor/graphene photocatalysts: Synthesis, photocatalytic applications, and challenges. *RSC Advances*, 13(1), 421–439. <https://doi.org/10.1039/D2RA07225D>
- Akash, M. S. H., & Rehman, K. (2020). *Essentials of Pharmaceutical Analysis*. Springer Nature Singapore. <https://doi.org/10.1007/978-981-15-1547-7>
- Akyol, A., & Bayramoglu, M. (2005). Photocatalytic degradation of Remazol Red F3B using ZnO catalyst. *Journal of Hazardous Materials*, 124(1–3), 241–246. <https://doi.org/10.1016/j.jhazmat.2005.05.006>
- Al-Nuaim, M. A., Alwasiti, A. A., & Shnain, Z. Y. (2023). The photocatalytic process in the treatment of polluted water. *Chemical Papers*, 77(2), 677–701. <https://doi.org/10.1007/s11696-022-02468-7>
- Andrade, P. H. M., Volkringer, C., Loiseau, T., Tejeda, A., Hureau, M., & Moissette, A. (2024). Band gap analysis in MOF materials: Distinguishing direct and indirect transitions using UV–vis spectroscopy. *Applied Materials Today*, 37, 102094. <https://doi.org/10.1016/j.apmt.2024.102094>
- Arya, S., Mahajan, P., Mahajan, S., Khosla, A., Datt, R., Gupta, V., Young, S.-J., & Oruganti, S. K. (2021). Review—Influence of Processing Parameters to Control Morphology and Optical Properties of Sol-Gel Synthesized ZnO Nanoparticles. *ECS Journal of Solid State Science and Technology*, 10(2), 023002. <https://doi.org/10.1149/2162-8777/abe095>
- Ashrafi, S. D., Kamani, H., Soheil Arezomand, H., Yousefi, N., & Mahvi, A. H. (2016). Optimization and modeling of process variables for adsorption of Basic Blue 41 on NaOH-modified rice husk using response surface methodology. *Desalination and Water Treatment*, 57(30), 14051–14059. <https://doi.org/10.1080/19443994.2015.1060903>
- Austin, E., Geisler, A. N., Nguyen, J., Kohli, I., Hamzavi, I., Lim, H. W., & Jagdeo, J. (2021). Visible light. Part I: Properties and cutaneous effects of visible light. *Journal of the American Academy of Dermatology*, 84(5), 1219–1231. <https://doi.org/10.1016/j.jaad.2021.02.048>
- Avraam, A., Alwan, W., & Technologies, A. (2024). *Determination of Band Gap in Metal Oxides Using UV-Vis Spectroscopy*. Agilent. www.agilent.com/chem/cary5000

- Ayu, Y. S., & Kasiamdari, R. S. (2022). Screening and identification of fungi isolated from batik wastewaters for decolorization of Remazol Black B dye and batik effluent. *Journal of Degraded and Mining Lands Management*, 10(1), 3829. <https://doi.org/10.15243/jdmlm.2022.101.3829>
- Azhagan, S. A. C., & Ganesan, S. (2017). Effect of zinc acetate addition on crystal growth, structural, optical, thermal properties of glycine single crystals. *Arabian Journal of Chemistry*, 10, S2615–S2624. <https://doi.org/10.1016/j.arabjc.2013.09.041>
- Aziz, A. T., & dkk. (2020). *Sintesis Komposit ZnO-Xanthan Gum Sebagai Fotokatalis untuk Fotodegradasi Zat Warna Methyl Orage*.
- Babu, A. K., Raja, M. K. M. M., Zehravi, M., Mohammad, B. D., Anees, M. I., Prasad, C., Yahya, B. A., Sultana, R., Sharma, R., Singh, J., Khan, K. A., Siddiqui, F. A., Khan, S. L., & Emran, T. B. (2023). An overview of polymer surface coated synthetic quantum dots as therapeutics and sensors applications. *Progress in Biophysics and Molecular Biology*, 184, 1–12. <https://doi.org/10.1016/j.pbiomolbio.2023.08.004>
- Baranov, A. N., Sokolov, P. S., & Solozhenko, V. L. (2022). ZnO under Pressure: From Nanoparticles to Single Crystals. *Crystals*, 12(5), 744. <https://doi.org/10.3390/cryst12050744>
- Bassi, A., Hasan, I., Qanungo, K., Koo, B. H., & Khan, R. A. (2022). Visible light assisted mineralization of malachite green dye by green synthesized xanthan gum/agar@ZnO bionanocomposite. *Journal of Molecular Structure*, 1256, 132518. <https://doi.org/10.1016/j.molstruc.2022.132518>
- Bharat, T. C., Shubham, Mondal, S., S. Gupta, H., Singh, P. K., & Das, A. K. (2019). Synthesis of Doped Zinc Oxide Nanoparticles: A Review. *Materials Today: Proceedings*, 11, 767–775. <https://doi.org/10.1016/j.matpr.2019.03.041>
- Boutra, B., Sebti, A., & Trari, M. (2022). Response surface methodology and artificial neural network for optimization and modeling the photodegradation of organic pollutants in water. *International Journal of Environmental Science and Technology*, 19(11), 11263–11278. <https://doi.org/10.1007/s13762-021-03875-1>
- Brändlin, M., Pfund, B., & Wenger, O. S. (2025). Photoinduced double charge accumulation in a molecular compound. *Nature Chemistry*. <https://doi.org/10.1038/s41557-025-01912-x>
- Breen, J. (2025). *CHM 331 Advanced Analytical Chemistry I*. National Science Foundation under Grant.
- Chaves, A., Azadani, J. G., Alsalman, H., Da Costa, D. R., Frisenda, R., Chaves, A. J., Song, S. H., Kim, Y. D., He, D., Zhou, J., Castellanos-Gomez, A., Peeters, F. M., Liu, Z., Hinkle, C. L., Oh, S.-H., Ye, P. D., Koester, S. J., Lee, Y. H., Avouris, Ph., ... Low, T. (2020). Bandgap engineering of two-dimensional semiconductor materials. *Npj 2D Materials and Applications*, 4(1), 29. <https://doi.org/10.1038/s41699-020-00162-4>
- Chinnasamy, E., Indumathi, N., Madhavan, J., & Senthil, S. (2017). Growth and Characterization of Zinc Acetate dihydrate Formic Acid Single Crystals. *Research*

- Chowdhury, A. P., Anantharaju, K. S., Keshavamurthy, K., & Rokhum, S. L. (2023). Recent Advances in Efficient Photocatalytic Degradation Approaches for Azo Dyes. *Journal of Chemistry*, 2023, 1–24. <https://doi.org/10.1155/2023/9780955>
- Corona-Rivera, M. A., Ovando-Medina, V. M., Bernal-Jacome, L. A., Cervantes-González, E., Antonio-Carmona, I. D., & Dávila-Guzmán, N. E. (2017). Remazol red dye removal using poly (acrylamide-co-acrylic acid) hydrogels and water absorbency studies. *Colloid and Polymer Science*, 295(1), 227–236. <https://doi.org/10.1007/s00396-016-3996-2>
- Da Silva, L. T. V., Crisóstomo, J. V. C., Da Silva, L. P., Monteiro, N. D. K. V., Oliveira, J. T., Do Nascimento, H. O., Longhinotti, E., Romero, F. B., De Oliveira, A. G., & Do Nascimento, R. F. (2025). Influence study of cationic surfactant, temperature, and current on the electrocoagulation process for removal of Remazol Red RB 133 by central composite design and response surface methodology. *Journal of Solid State Electrochemistry*, 29(8), 3265–3291. <https://doi.org/10.1007/s10008-024-05959-7>
- Davis, K., Yarbrough, R., Froeschle, M., White, J., & Rathnayake, H. (2019). Band gap engineered zinc oxide nanostructures via a sol–gel synthesis of solvent driven shape-controlled crystal growth. *RSC Advances*, 9(26), 14638–14648. <https://doi.org/10.1039/C9RA02091H>
- De Los Santos, E. A. G., Lozano-Gonzalez, M. J., & Johnson, A. F. (1999). Photoresponsive Polyurethane-Acrylate Copolymers. In *Coloring Technology for Plastics* (pp. 79–86). Elsevier. <https://doi.org/10.1016/B978-188420778-5.50011-5>
- Díaz, C., Cifuentes-Vaca, O., & Valenzuela, M. L. (2023). Matrix Effect of Properties of Au, ZnO and Eu₂O₃: Silica, Titania and Alumina Matrices. *Micro*, 3(3), 699–714. <https://doi.org/10.3390/micro3030049>
- Disha, S. A., Sahadat Hossain, Md., Habib, Md. L., & Ahmed, S. (2024). Calculation of crystallite sizes of pure and metals doped hydroxyapatite engaging Scherrer method, Halder-Wagner method, Williamson-Hall model, and size-strain plot. *Results in Materials*, 21, 100496. <https://doi.org/10.1016/j.rinma.2023.100496>
- Donia, D. T., Bauer, E. M., Missori, M., Roselli, L., Cecchetti, D., Tagliatesta, P., Gontrani, L., & Carbone, M. (2021). Room Temperature Syntheses of ZnO and Their Structures. *Symmetry*, 13(4), 733. <https://doi.org/10.3390/sym13040733>
- Dwiriani, D., Efendi, M. Z., Aritonang, R., & Lestari, T. U. (2025). *Band Gap Energy Characteristics in Materials*. 3(2).
- Ebrahiminezhad, A., Moeeni, F., Taghizadeh, S.-M., Seifan, M., Bautista, C., Novin, D., Ghasemi, Y., & Berenjian, A. (2019). Xanthan Gum Capped ZnO Microstars as a Promising Dietary Zinc Supplementation. *Foods*, 8(3), 88. <https://doi.org/10.3390/foods8030088>
- El-Dossoki, F. I., Atwee, T. M., Hamada, A. M., & El-Bindary, A. A. (2021). Photocatalytic degradation of Remazol Red B and Rhodamine B dyes using TiO₂ nanomaterial: Estimation of the effective operating parameters. *Desalination and Water Treatment*, 233, 319–330. <https://doi.org/10.5004/dwt.2021.27519>

- Elhamdi, I., Souissi, H., Taktak, O., Elghoul, J., Kammoun, S., Dhahri, E., & Costa, B. F. O. (2022). Experimental and modeling study of ZnO:Ni nanoparticles for near-infrared light emitting diodes. *RSC Advances*, 12(21), 13074–13086. <https://doi.org/10.1039/D2RA00452F>
- Febriani, R., Knippenberg, L., & Aarts, N. (2023). The making of a national icon: Narratives of batik in Indonesia. *Cogent Arts & Humanities*, 10(1), 2254042. <https://doi.org/10.1080/23311983.2023.2254042>
- Furtado, I. F. S. P. C., Sydney, E. B., Rodrigues, S. A., & Sydney, A. C. N. (2022). Xanthan gum: Applications, challenges, and advantages of this asset of biotechnological origin. *Biotechnology Research and Innovation*, 6(1), e202204. <https://doi.org/10.4322/biori.202205>
- Gabriel Kwame Sipi Takyi, Emmanuel Nyankson, Maxwell Selasse Akple, Abu Yaya, & Gamaralalege Rajanya Asoka Kumara. (2024). Influence of Hydrothermal Temperature Variation and Annealing on ZnO Nanoparticles on the Performance of Photoanode in DSSC. *Biointerface Research in Applied Chemistry*, 14(3), 75. <https://doi.org/10.33263/BRIAC143.075>
- Gazem, A., Krishna, S., & Al-Yaseri, A. (2025). Low-salinity enhanced oil recovery using biosurfactant-ZnO nanoparticle-xanthan gum formulations: A comparative study of rhamnolipid and sophorolipid systems. *Journal of Molecular Liquids*, 432, 127894. <https://doi.org/10.1016/j.molliq.2025.127894>
- Ghelich, R., Jahannama, M. R., Abdizadeh, H., Torknik, F. S., & Vaezi, M. R. (2019). Central composite design (CCD)-Response surface methodology (RSM) of effective electrospinning parameters on PVP-B-Hf hybrid nanofibrous composites for synthesis of HfB₂-based composite nanofibers. *Composites Part B: Engineering*, 166, 527–541. <https://doi.org/10.1016/j.compositesb.2019.01.094>
- Grace, M. A. L., Veerabhadra Rao, K., Anuradha, K., Judith Jayarani, A., Arun Kumar, A., & Rathika, A. (2023). X-ray analysis and size-strain plot of zinc oxide nanoparticles by Williamson-Hall. *Materials Today: Proceedings*, 92, 1334–1339. <https://doi.org/10.1016/j.matpr.2023.05.492>
- Guo, Y., Liu, C., Ye, R., & Duan, Q. (2020). Advances on Water Quality Detection by UV-Vis Spectroscopy. *Applied Sciences*, 10(19), 6874. <https://doi.org/10.3390/app10196874>
- Gürses, A., Güneş, K., Şahin, E., & Açıkyıldız, M. (2023). Investigation of the removal kinetics, thermodynamics and adsorption mechanism of anionic textile dye, Remazol Red RB, with powder pumice, a sustainable adsorbent from waste water. *Frontiers in Chemistry*, 11, 1156577. <https://doi.org/10.3389/fchem.2023.1156577>
- Gutierrez-Mata, A. G., Velazquez-Martínez, S., Álvarez-Gallegos, A., Ahmadi, M., Hernández-Pérez, J. A., Ghanbari, F., & Silva-Martínez, S. (2017). Recent Overview of Solar Photocatalysis and Solar Photo-Fenton Processes for Wastewater Treatment. *International Journal of Photoenergy*, 2017, 1–27. <https://doi.org/10.1155/2017/8528063>
- Hait, P., Mehta, R., & Basu, S. (2025). Ultrafast charge separation and photostability in PANI/GO/MoO₃ ternary nanocomposites for dual-function solar photocatalysis:

- Enhanced dye degradation and hydrogen evolution under visible light. *New Journal of Chemistry*, 10.1039.D5NJ02247A. <https://doi.org/10.1039/D5NJ02247A>
- Hakim, G. L., Envirotek, A. P., Envirotek, P. M., & Envirotek, H. T. B. M. P. (2025). Studi Optimasi Komposisi Red Mud dan Asam Sitrat untuk Phytomining. *JURNAL ENVIROTEK*, 16(2). <https://doi.org/10.33005/envirotek.v16i2.1921>
- Harrington, G. F., & Santiso, J. (2021). Back-to-Basics tutorial: X-ray diffraction of thin films. *Journal of Electroceramics*, 47(4), 141–163. <https://doi.org/10.1007/s10832-021-00263-6>
- Hasan, I., Shekhar, C., Bin Sharfan, I. I., Khan, R. A., & Alsalmeh, A. (2020). Ecofriendly Green Synthesis of the ZnO-Doped CuO@Alg Bionanocomposite for Efficient Oxidative Degradation of *p* -Nitrophenol. *ACS Omega*, 5(49), 32011–32022. <https://doi.org/10.1021/acsomega.0c04917>
- Hasanpour, M., Motahari, S., Jing, D., & Hatami, M. (2021). Statistical analysis and optimization of photodegradation efficiency of methyl orange from aqueous solution using cellulose/zinc oxide hybrid aerogel by response surface methodology (RSM). *Arabian Journal of Chemistry*, 14(11), 103401. <https://doi.org/10.1016/j.arabjc.2021.103401>
- Hossain, M. A., Kayes, Md. N., & Hossain, Md. M. (2021). Removal of Remazol Red RR from Aqueous Solution by Glass Supported Films of Synthesized ZnO Nanoparticles. *ICRRD Quality Index Research Journal*, 2(3). <https://doi.org/10.53272/icrrd.v2i3.2>
- Huang, R., Zhang, S., Zhang, W., & Yang, X. (2021). Progress of zinc oxide-based nanocomposites in the textile industry. *IET Collaborative Intelligent Manufacturing*, 3(3), 281–289. <https://doi.org/10.1049/cim2.12029>
- Husain, F. M., Hasan, I., Qais, F. A., Khan, R. A., Alam, P., & Alsalmeh, A. (2020). Fabrication of Zinc Oxide-Xanthan Gum Nanocomposite via Green Route: Attenuation of Quorum Sensing Regulated Virulence Functions and Mitigation of Biofilm in Gram-Negative Bacterial Pathogens. *Coatings*, 10(12), 1190. <https://doi.org/10.3390/coatings10121190>
- Ikram, M., Naeem, M., Zahoor, M., Rahim, A., Hanafiah, M. M., Oyekanmi, A. A., Shah, A. B., Mahnashi, M. H., Al Ali, A., Jalal, N. A., Bantun, F., & Sadiq, A. (2022). Biodegradation of Azo Dye Methyl Red by *Pseudomonas aeruginosa*: Optimization of Process Conditions. *International Journal of Environmental Research and Public Health*, 19(16), 9962. <https://doi.org/10.3390/ijerph19169962>
- Iqhrammullah, M., Marlina, & Nur, S. (2020). Adsorption Behaviour of Hazardous Dye (Methyl Orange) on Cellulose-Acetate Polyurethane Sheets. *IOP Conference Series: Materials Science and Engineering*, 845(1), 012035. <https://doi.org/10.1088/1757-899X/845/1/012035>
- Jonuškienė, I., Davicijonaitė, E., Vaškevičiūtė, M., Kala, I., Stankevičienė, R., Kantminienė, K., & Tumosienė, I. (2025). Sustainable Production and Antioxidant Activity of Bacterial Xanthan Gum. *Molecules*, 30(13), 2734. <https://doi.org/10.3390/molecules30132734>
- Jubu, P. R., Chahrour, K. M., Muhammad, A., Landi, S., Obaseki, O. S., Igbawua, T., Gundu, A. A., Chahul, H. F., & Yam, F. K. (2023). *Considerations About the*

- Kamarulzaman, N., Kasim, M. F., & Rusdi, R. (2015). Band Gap Narrowing and Widening of ZnO Nanostructures and Doped Materials. *Nanoscale Research Letters*, 10(1), 346. <https://doi.org/10.1186/s11671-015-1034-9>
- Kanwal, F., Javed, T., Hussain, F., Wasim, M., & Batool, M. (2024). Enhanced dye photodegradation through ZnO and ZnO-based photocatalysts doped with selective transition metals: A review. *Environmental Technology Reviews*, 13(1), 754–793. <https://doi.org/10.1080/21622515.2024.2426725>
- Kassouf, N., Zappi, A., Monticelli, M., & Melucci, D. (2024). Analysis of Solid Formulates Using UV-Visible Diffused Reflectance Spectroscopy with Multivariate Data Processing Based on Net Analyte Signal and Standard Additions Method. *Chemosensors*, 12(11), 227. <https://doi.org/10.3390/chemosensors12110227>
- Kaur, D., Bharti, A., Sharma, T., & Madhu, C. (2021). Dielectric Properties of ZnO-Based Nanocomposites and Their Potential Applications. *International Journal of Optics*, 2021, 1–20. <https://doi.org/10.1155/2021/9950202>
- Kiteto, M. K., & Mecha, C. A. (2024). Insight into the Bouguer-Beer-Lambert Law: A review. *Sustainable Chemical Engineering*, 567–587. <https://doi.org/10.37256/sce.5220245325>
- Klein, J., Kampermann, L., Mockenhaupt, B., Behrens, M., Strunk, J., & Bacher, G. (2023). Limitations of the Tauc Plot Method. *Advanced Functional Materials*, 33(47), 2304523. <https://doi.org/10.1002/adfm.202304523>
- Kotsol, I., & Severa, G. (2025). Characterization and SO₂ Sorption Performance of Zn₃[OAc]₈[C₂ mim]₂, a Metal-Based Ionic Liquid. *ACS Omega*, 10(7), 7400–7406. <https://doi.org/10.1021/acsomega.4c11605>
- Kowalska, M., Turek, P., Żbikowska, A., Babut, M., & Szakiel, J. (2021). The Quality of Emulsions with New Synthetized Lipids Stabilized by Xanthan Gum. *Biomolecules*, 11(2), 213. <https://doi.org/10.3390/biom11020213>
- Krisandi, A., Heru Harsono, & Nurfina Yudasari. (2024). Pengaruh Dopping Mn Pada Semikonduktor AZO Terhadap Laju Fotodegradasi Pewarna Tekstil Congo Red Menggunakan Radiasi UV A. *Kappa Journal*, 8(2), 255–261. <https://doi.org/10.29408/kpj.v8i2.25497>
- K.S., J., Jose, J., Li, T., Thomas, M., Shankregowda, A. M., Sreekumaran, S., Kalarikkal, N., & Thomas, S. (2020). Application of novel zinc oxide reinforced xanthan gum hybrid system for edible coatings. *International Journal of Biological Macromolecules*, 151, 806–813. <https://doi.org/10.1016/j.ijbiomac.2020.02.085>
- Kumar, R., & Reji, M. (2023). Response surface methodology (RSM): An overview to analyze multivariate data. *Indian Journal of Microbiology Research*, 9(4), 241–248. <https://doi.org/10.18231/j.ijmr.2022.042>
- Kumari, H., Sonia, Suman, Ranga, R., Chahal, S., Devi, S., Sharma, S., Kumar, S., Kumar, P., Kumar, S., Kumar, A., & Parmar, R. (2023). A Review on Photocatalysis Used for Wastewater Treatment: Dye Degradation. *Water, Air, & Soil Pollution*, 234(6), 349. <https://doi.org/10.1007/s11270-023-06359-9>

- Lad, M., Todd, T., Morris, G. A., MacNaughtan, W., Sworn, G., & Foster, T. J. (2013). On the origin of sharp peaks in the X-ray diffraction patterns of xanthan powders. *Food Chemistry*, 139(1–4), 1146–1151. <https://doi.org/10.1016/j.foodchem.2013.01.096>
- Le, A. T., Pung, S. Y., Chiam, S. L., Josoh, N. A. H. Bt. N., Koay, T. Y., Lee, J. S., & Mustar, N. B. (2020). *Photocatalytic performance of TiO₂ particles in degradation of various organic dyes under visible and UV light irradiation*. 020017. <https://doi.org/10.1063/5.0016025>
- Lemyre, F. C., Chalifoux, K., Desharnais, B., & Mireault, P. (2022). Squaring Things Up with R2: What It Is and What It Can (and Cannot) Tell You. *Journal of Analytical Toxicology*, 46(4), 443–448. <https://doi.org/10.1093/jat/bkab036>
- Letsiou, S., Koldiri, E., Beloukas, A., Rallis, E., & Kefala, V. (2024). Deciphering the Effects of Different Types of Sunlight Radiation on Skin Function: A Review. *Cosmetics*, 11(3), 80. <https://doi.org/10.3390/cosmetics11030080>
- Li, G., Xie, J., Wang, J., Xia, L., Li, Y., & Hu, W. (2019). Nanoscale Surface Disorder for Enhanced Solar Absorption and Superior Visible-Light Photocatalytic Property in Ti-Rich BaTiO₃ Nanocrystals. *ACS Omega*, 4(6), 9673–9679. <https://doi.org/10.1021/acsomega.9b00739>
- Li, S., Chen, X., Cheng, Z., Luo, S., Nguyen, T. T., Guo, M., & Gao, X. (2021). Promoting effect of cellulose-based carbon dots at different concentrations on multifunctional photocatalytic degradation of dyes by ZnO. *Optical Materials*, 121, 111591. <https://doi.org/10.1016/j.optmat.2021.111591>
- Lim, N. Y. Y., Chiam, S. L., Leo, C. P., & Chang, C. K. (2024). Recent modification, mechanisms, and performance of zinc oxide-based photocatalysts for sustainable dye degradation. *Hybrid Advances*, 7, 100318. <https://doi.org/10.1016/j.hybadv.2024.100318>
- Maduelosi, J. N., & Ezuluofor, M. U. (2023). Education as a Vaccine Against Girl Child Bullying. *British Journal of Multidisciplinary and Advanced Studies*, 4(3), 1–8. <https://doi.org/10.37745/bjmas.2022.0207>
- Maijan, P., Waen-ngoen, T., Suwanboon, S., & Voravuthikunchai, S. P. (2024). Sustainable environmental-based synthesis of zinc oxide nanoparticles using para rubber leaf extract for photocatalytic degradation of organic pollutants and microbial control in wastewater treatment. *Inorganic Chemistry Communications*, 162, 112086. <https://doi.org/10.1016/j.inoche.2024.112086>
- Mehr, M. E., Maleki-Ghaleh, H., Yarahmadi, M., Kavanlouei, M., & Siadati, M. H. (2021). Synthesis and characterization of photocatalytic zinc oxide/titanium oxide (core/shell) nanocomposites. *Journal of Alloys and Compounds*, 882, 160777. <https://doi.org/10.1016/j.jallcom.2021.160777>
- Michael, P. (2019). *A Conversion Guide: Solar Irradiance and Lux Illuminance* [Dataset]. IEEE DataPort. <https://doi.org/10.21227/MXR7-P365>
- Mokari, A., Guo, S., & Bocklitz, T. (2023). Exploring the Steps of Infrared (IR) Spectral Analysis: Pre-Processing, (Classical) Data Modelling, and Deep Learning. *Molecules*, 28(19), 6886. <https://doi.org/10.3390/molecules28196886>

- Molla, A., Hoque, M. M., Richi, F. T., Kabir, M. H., Alam, S., Ahmed, N. U., Emon, N. U., Shao, C., Zeng, C., Wang, S., Geng, P., & Mamun, A. A. (2025). Biosynthesis and Characterization of ZnO Nanoparticles Using Citrus reticulata Peel Followed by Photocatalytic, Antibacterial, and Antioxidative Nanotherapeutic Attributes Assessment Supported by Computer Simulation. *International Journal of Nanomedicine, Volume 20*, 4803–4829. <https://doi.org/10.2147/IJN.S493905>
- Morab, S., Sundaram, M. M., & Pivrikas, A. (2023). Review on Charge Carrier Transport in Inorganic and Organic Semiconductors. *Coatings, 13*(9), 1657. <https://doi.org/10.3390/coatings13091657>
- Mubeen, K., Irshad, A., Safeen, A., Aziz, U., Safeen, K., Ghani, T., Khan, K., Ali, Z., Ul Haq, I., & Shah, A. (2023). Band structure tuning of ZnO/CuO composites for enhanced photocatalytic activity. *Journal of Saudi Chemical Society, 27*(3), 101639. <https://doi.org/10.1016/j.jscs.2023.101639>
- Mursyalaat, V., Variiani, V. I., Arsyad, W. O. S., & Firihi, M. Z. (2023). The development of program for calculating the band gap energy of semiconductor material based on UV-Vis spectrum using delphi 7.0. *Journal of Physics: Conference Series, 2498*(1), 012042. <https://doi.org/10.1088/1742-6596/2498/1/012042>
- Mustafa, G., Zahid, M. T., Bharat Kurade, M., Mahadeo Patil, S., Shakoori, F. R., Shafiq, Z., Ihsan, S., Ahn, Y., Khan, A. A., Gacem, A., & Jeon, B. (2023). Molecular characterization of azoreductase and its potential for the decolorization of Remazol Red R and Acid Blue 29. *Environmental Pollution, 335*, 122253. <https://doi.org/10.1016/j.envpol.2023.122253>
- Muthukumar, C., Iype, E., Raju, K., Pulletikurthi, S., & Prakash Kumar, B. G. (2022). Sunlight assisted photocatalytic degradation using the RSM-CCD optimized sustainable photocatalyst synthesized from galvanic wastewater. *Journal of Molecular Structure, 1263*, 133194. <https://doi.org/10.1016/j.molstruc.2022.133194>
- Nandiyanto, A. B. D., Ragadhita, R., & Aziz, M. (2023). How to Calculate and Measure Solution Concentration using UV-Vis Spectrum Analysis: Supporting Measurement in the Chemical Decomposition, Photocatalysis, Phytoremediation, and Adsorption Process. *Indonesian Journal of Science & Technology, 8*(2), 345–362. <https://doi.org/10.17509/ijost.v8i2.57783>
- Naseem, T., & Durrani, T. (2021). The role of some important metal oxide nanoparticles for wastewater and antibacterial applications: A review. *Environmental Chemistry and Ecotoxicology, 3*, 59–75. <https://doi.org/10.1016/j.enceco.2020.12.001>
- Ningrum, R. B. S. (2019). *Pengaruh Temperature Kalsinasi dalam Sintesis ZnO-Xanthan Gum sebagai Fotokatalis untuk Fotodegradasi Zat Warna Methyl Orange* [Thesis]. Universitas Islam Negri Sunan Kalijaga.
- Nishigori, C., Yamano, N., Kunisada, M., Nishiaki-Sawada, A., Ohashi, H., & Igarashi, T. (2023). Biological Impact of Shorter Wavelength Ultraviolet RADIATION-C[†]. *Photochemistry and Photobiology, 99*(2), 335–343. <https://doi.org/10.1111/php.13742>
- Olowookere, C. J., Otiko, M. M., Akintomide, J., Aladeniyi, K., & Okunlola, O. O. (2022). Assessment of Daily and Annual Ultraviolet Radiation Doses Received by

Outdoor Workers in Southwestern Nigeria. *Journal of Applied Sciences and Environmental Management*, 26(6), 983–989.
<https://doi.org/10.4314/jasem.v26i6.1>

- Panthi, V. K., Jha, S. K., Chaubey, R., & Pangeni, R. (2021). Formulation and development of Serratiopeptidase enteric coated tablets and analytical method validation by UV Spectroscopy. *International Journal of Analytical Chemistry*, 2021, 1–13. <https://doi.org/10.1155/2021/9749474>
- Park, J., Rim, Y. S., Senanayake, P., Wu, J., & Streit, D. (2020). Electrical Defect State Distribution in Single Crystal ZnO Schottky Barrier Diodes. *Coatings*, 10(3), 206. <https://doi.org/10.3390/coatings10030206>
- Patel, D. K., Seo, Y.-R., Dutta, S. D., Lee, O. H., & Lim, K.-T. (2020). Influence of Maitake (*Grifola frondosa*) Particle Sizes on Human Mesenchymal Stem Cells and *In Vivo* Evaluation of Their Therapeutic Potential. *BioMed Research International*, 2020(1), 8193971. <https://doi.org/10.1155/2020/8193971>
- Pawlicka, A., Tavares, F. C., Dörr, D. S., Cholant, C. M., Ely, F., Santos, M. J. L., & Avellaneda, C. O. (2019). Dielectric behavior and FTIR studies of xanthan gum-based solid polymer electrolytes. *Electrochimica Acta*, 305, 232–239. <https://doi.org/10.1016/j.electacta.2019.03.055>
- Peng, Z., Zhou, Y., Ji, C., Pardo, J., Mintz, K. J., Pandey, R. R., Chusuei, C. C., Graham, R. M., Yan, G., & Leblanc, R. M. (2020). Facile Synthesis of “Boron-Doped” Carbon Dots and Their Application in Visible-Light-Driven Photocatalytic Degradation of Organic Dyes. *Nanomaterials*, 10(8), 1560. <https://doi.org/10.3390/nano10081560>
- Perera, K. S. D. (2022). Infrared Spectroscopy. *Chemistry in Sri Lanka*, 39, 66–70. [http://repository.ou.ac.lk/bitstream/handle/94ousl/2814/19.%20IR%20CSL%202022%2039\(1\)%2066-70.pdf?sequence=1](http://repository.ou.ac.lk/bitstream/handle/94ousl/2814/19.%20IR%20CSL%202022%2039(1)%2066-70.pdf?sequence=1)
- Phillips, G. O., & Williams, P. A. (Eds.). (2021). *Handbook of hydrocolloids* (Third edition). Elsevier Woodhead Publishing.
- Pratiwi, R. A., & Nandiyanto, A. B. D. (2022). How to Read and Interpret UV-VIS Spectrophotometric Results in Determining the Structure of Chemical Compounds. *Indonesian Journal of Educational Research and Technology*, 2(1), 1–20. <https://doi.org/10.17509/ijert.v2i1.35171>
- Purwaningrum, W., Sari, F. P., Julinar, J., Ahmadi, A., & Said, M. (2022). Effect of Al Concentration over ZnO-Al₂O₃ Physicochemical Characteristics and Removal of Remazol Red RB. *ASEAN Journal of Chemical Engineering*, 22(2), 206. <https://doi.org/10.22146/ajche.70084>
- Rajendran, G., Datta, S. P., Singh, R. D., Datta, S. C., & Vakada, M. (2022). Synthesis and characterization of ZnO nanoparticles – comparison of acetate (*precursor*) based methods. *Inorganic and Nano-Metal Chemistry*, 52(2), 185–194. <https://doi.org/10.1080/24701556.2021.1891099>
- Reddy, K. S., & Reddy, Dr. S. (2025). X-ray diffraction: A non-destructive technique for crystalline structure analysis. *International Journal of Chemical Research and Development*, 7(1), 63–66. <https://doi.org/10.33545/26646552.2025.v7.i1a.81>

- Rosa, D., D'Agostino, F., Bavasso, I., Bracciale, M. P., & Di Palma, L. (2023). Easy way to produce iron-doped titania nanoparticles via the solid-state method and investigation their photocatalytic activity. *Journal of Materials Research*, 38(5), 1282–1292. <https://doi.org/10.1557/s43578-022-00885-8>
- Sahadat Hossain, Md., Tarannum, S., Kawsar, Md., Bahadur, N. M., & Ahmed, S. (2024). Synthesis of pure and Cd-doped hydroxyapatite for the photo-catalytic degradation of Amoxicillin and Ciprofloxacin: Crystallographic characterization using XRD. *Journal of Hazardous Materials Advances*, 13, 100406. <https://doi.org/10.1016/j.hazadv.2024.100406>
- Salehi, G., Bagherzadeh, M., Abazari, R., Hajilo, M., & Taherinia, D. (2024). Visible Light-Driven Photocatalytic Degradation of Methylene Blue Dye Using a Highly Efficient Mg–Al LDH@g-C₃N₄@Ag₃PO₄ Nanocomposite. *ACS Omega*, 9(4), 4581–4593. <https://doi.org/10.1021/acsomega.3c07326>
- Sales, D. A., Jerônimo, A. G., Trigueiro, P., Albuquerque, W., Barbosa, R., Neves, L., Almeida, L. C., Guerra, Y., Osajima, J. A., Padrón-Hernández, E., Viana, B. C., & Peña-Garcia, R. R. (2025). Synergistic effects of Al³⁺/La³⁺ co-doped ZnO photocatalysts for enhanced removal of Remazol red dye and Diclofenac in aqueous solutions. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 709, 136130. <https://doi.org/10.1016/j.colsurfa.2025.136130>
- Santos, T. D. S., Lemos, P. V. F., Santana, J. S., Anias, F. A. S., Assis, D. D. J., Cardoso, L. G., Marcelino, H. R., Souza, E. F. D., Silva, J. B. A. D., & Souza, C. O. D. (2024). Characterization of xanthan gum–metal complexes biosynthesized using a medium containing produced water and cassava processing residues. *International Journal of Biological Macromolecules*, 282, 137229. <https://doi.org/10.1016/j.ijbiomac.2024.137229>
- Sarker, S. D., & Nahar, L. (2024). Response surface methodology (RSM) in phytochemical research. In *Computational Phytochemistry* (pp. 59–90). Elsevier. <https://doi.org/10.1016/B978-0-443-16102-5.00007-9>
- Sarwar, T., & Khan, S. (2022). Textile Industry: Pollution Health Risks and Toxicity. In S. S. Muthu & A. Khadir (Eds.), *Textile Wastewater Treatment* (pp. 1–28). Springer Nature Singapore. https://doi.org/10.1007/978-981-19-2832-1_1
- Scholtz, L., Eckert, J. G., Graf, R. T., Kunst, A., Wegner, K. D., Bigall, N. C., & Resch-Genger, U. (2024). Correlating semiconductor nanoparticle architecture and applicability for the controlled encoding of luminescent polymer microparticles. *Scientific Reports*, 14(1), 11904. <https://doi.org/10.1038/s41598-024-62591-1>
- Sethi, S., Saruchi, Kaith, B. S., Kaur, M., Sharma, N., & Kumar, V. (2020). Cross-linked xanthan gum–starch hydrogels as promising materials for controlled drug delivery. *Cellulose*, 27(8), 4565–4589. <https://doi.org/10.1007/s10570-020-03082-0>
- Sharma, G., Kumar, A., Ghfar, A. A., García-Peñas, A., Naushad, Mu., & Stadler, F. J. (2021). Fabrication and Characterization of Xanthan Gum-cl-poly(acrylamide-co-alginic acid) Hydrogel for Adsorption of Cadmium Ions from Aqueous Medium. *Gels*, 8(1), 23. <https://doi.org/10.3390/gels8010023>
- Sikiru, S., Busari, Y. O., Olutoki, J. O., Mahat, M. M., & Kolawole, S. Y. (2025). Recent Advances in Polymer-Based Photocatalysts for Environmental Remediation and

- Souleh, K., Smain, T., Lidjici, H., Lagoun, B., Boucenna, M., & Bouarissa, N. (2021). *Electronic structure and magnetization of $Zn_{1-x}Co_xO$ ternary alloys with zinc-blende, rocksalt and wurtzite phases*. In Review. <https://doi.org/10.21203/rs.3.rs-344425/v1>
- Sowunmi, A., Orodu, O., Efeovbokhan, V., & Ogundare, S. (2020). Comparative dataset on the characterization of natural polymers and nanocomposites for enhanced oil recovery. *Data in Brief*, 33, 106506. <https://doi.org/10.1016/j.dib.2020.106506>
- Sukarta, I. N., Sri Ayuni, N. P., & Sastrawidana, I. D. (2021). Utilization of Khamir (*Saccharomyces cerevisiae*) as Adsorbent of Remazol Red RB Textile Dyes. *Ecological Engineering & Environmental Technology*, 22(1), 117–123. <https://doi.org/10.12912/27197050/132087>
- Sulaiman, N. F., Mubin, M. H. A., Gunasekaran, S. S., Sofiah, A. G. N., Chaudhary, K. T., Mohamad, S. N., & Ali, J. (2025). Optimization using RSM-CCD in the fabrication of magnesium-doped bismuth ferrite nanoparticles via sol–gel auto-combustion method for enhanced photocatalytic performance. *Results in Physics*, 69, 108114. <https://doi.org/10.1016/j.rinp.2025.108114>
- Sun, N., Si, X., He, L., Zhang, J., & Sun, Y. (2024). Strategies for enhancing the photocatalytic activity of semiconductors. *International Journal of Hydrogen Energy*, 58, 1249–1265. <https://doi.org/10.1016/j.ijhydene.2024.01.319>
- Surdu, V.-A., & György, R. (2023). X-ray Diffraction Data Analysis by Machine Learning Methods—A Review. *Applied Sciences*, 13(17), 9992. <https://doi.org/10.3390/app13179992>
- Suryaningrum, A., Imelda Fajriati, Didik Krisdiyanto, & Irwan Nugraha. (2018). *Xanthan gum/titanium dioxide nanocomposite for photocatalytic degradation of methyl orange dye*. 1–6.
- Syed Shaharuddin, S. I., Shamsuddin, M. S., Drahman, M. H., Hasan, Z., Mohd Asri, N. A., Nordin, A. A., & Shaffiar, N. M. (2021). A Review on the Malaysian and Indonesian Batik Production, Challenges, and Innovations in the 21st Century. *Sage Open*, 11(3), 21582440211040128. <https://doi.org/10.1177/21582440211040128>
- Tabassum, Z., Girdhar, M., Kumar, A., Malik, T., & Mohan, A. (2023). ZnO Nanoparticles-Reinforced Chitosan–Xanthan Gum Blend Novel Film with Enhanced Properties and Degradability for Application in Food Packaging. *ACS Omega*, 8(34), 31318–31332. <https://doi.org/10.1021/acsomega.3c03763>
- Theocharidou, A., Lousinian, S., Tsagkaris, A., Mourtzinis, I., & Ritzoulis, C. (2024). Interactions between xanthan gum and phenolic acids. *International Journal of Biological Macromolecules*, 273, 133175. <https://doi.org/10.1016/j.ijbiomac.2024.133175>
- Tian, J., Dungait, J. A. J., Hou, R., Deng, Y., Hartley, I. P., Yang, Y., Kuzyakov, Y., Zhang, F., Cotrufo, M. F., & Zhou, J. (2024). Microbially mediated mechanisms underlie soil carbon accrual by conservation agriculture under decade-long warming. *Nature Communications*, 15(1), 377. <https://doi.org/10.1038/s41467-023-44647-4>

- Isaviv, J. N., Eneji, I. S., Sha'Ato, R., Ahemen, I., Jubu, P. R., & Yusof, Y. (2024). Photodegradation, kinetics and non-linear error functions of methylene blue dye using SrZrO₃ perovskite photocatalyst. *Heliyon*, 10(14), e34517. <https://doi.org/10.1016/j.heliyon.2024.e34517>
- Usman, A. K., Aris, A., Labaran, B. A., Darwish, M., & Jagaba, A. H. (2022). Effect of Calcination Temperature on the Morphology, Crystallinity, and Photocatalytic Activity of ZnO/TiO₂ in Selenite Photoreduction from Aqueous Phase. *Journal of New Materials for Electrochemical Systems*, 25(4), 251–258. <https://doi.org/10.14447/jnmes.v25i4.a05>
- UVEXS. (2025, September 9). UV Energy. *UV ENERGY*. <https://uvexs.com/uv-energy/>
- Vasiljevic, Z. Z., Dojcinovic, M. P., Vujancevic, J. D., Jankovic-Castvan, I., Ognjanovic, M., Tadic, N. B., Stojadinovic, S., Brankovic, G. O., & Nikolic, M. V. (2020). Photocatalytic degradation of methylene blue under natural sunlight using iron titanate nanoparticles prepared by a modified sol–gel method. *Royal Society Open Science*, 7(9), 200708. <https://doi.org/10.1098/rsos.200708>
- Weldekirstos, H. D., Mengist, T., Belachew, N., & Mekonnen, M. L. (2024). Enhanced photocatalytic degradation of methylene blue dye using facilely synthesized g-C₃N₄/CoFe₂O₄ composite under sun light irradiation. *Results in Chemistry*, 7, 101306. <https://doi.org/10.1016/j.rechem.2024.101306>