



## REFERENCES

- Abdi, M.M., Ekramul Mahmud, H.N.M., Abdullah, L.C., Kassim, A., Rahman, M.Z.A., and Chyi, J.L.Y., 2012, Optical Band Gap and Conductivity Measurements of Polypyrrole-Chitosan Composite Thin Films, *Chinese J. Polym. Sci.*, 30, 93–100.
- Adeniyi, A.A., Ngake, T.L., and Conradie, J., 2020, Cyclic Voltammetric Study of 2-Hydroxybenzophenone (HBP) Derivatives and the Correspondent Change in the Orbital Energy Levels in Different Solvents, *Electroanalysis*, 32, 2659–2668.
- Al-Qurashi, O.S., Wazzan, N.A., and Obot, I.B., 2020, Exploring The Effect Of mono- And di-Fluorinated Triphenylamine-based Molecules as Electron Donors for Dye-Sensitised Solar Cells, *Mol. Simul.*, 46, 41–53.
- Alghunaim, N.S., 2018, Molecular Modeling Evaluation of Silicon/Polyaniline/ZnO Nanocomposite, *J. Inorg. Organomet. Polym. Mater.*, 28, 2721–2729.
- Amalina, A.N., Suendo, V., Reza, M., Milana, P., Sunarya, R.R., Adhika, D.R., and Tanuwijaya, V. V., 2019, Preparation of Polyaniline Emeraldine Salt for Conducting-Polymer-Activated Counter Electrode in Dye-Sensitized Solar Cell (DSSC) Using Rapid-Mixing Polymerization at Various Temperature, *Bull. Chem. React. Eng. Catal.*, 14, 521.
- Anaya-Esparza, L.M., Ruvalcaba-Gómez, J.M., Maytorena-Verdugo, C.I., González-Silva, N., Romero-Toledo, R., Aguilera-Aguirre, S., Pérez-Larios, A., and Montalvo-González, E., 2020, Chitosan-TiO<sub>2</sub>: A Versatile Hybrid Composite, *Materials (Basel)*, 13, 811.
- Angel, R. Del, Durán-Álvarez, J.C., and Zanella, R., 2018, TiO<sub>2</sub>-Low Band Gap Semiconductor Heterostructures for Water Treatment Using Sunlight-Driven Photocatalysis, In, *Titanium Dioxide - Material for a Sustainable Environment*. InTech.
- Aprilia, A., Safriani, L., Arsyad, W.O.S., Syakir, N., Susilawati, T., Mulyana, C., Fitrialawati, and Hidayat, R., 2017, Zinc Oxide/TiO<sub>2</sub> Bilayer Heterojunction as a Working Electrode in Quasi Solid Dye Sensitized Solar Cells, *IOP Conf. Ser. Mater. Sci. Eng.*, 214, 012033.
- Aristov, N. and Habekost, A., 2015, Cyclic Voltammetry - A Versatile Electrochemical Method Investigating Electron Transfer Processes, *World J. Chem. Educ.*, 3, 115–119.
- Asnawi, A.S.F.M., Aziz, S.B., Nofal, M.M., Hamsan, M.H., Brza, M.A., Yusof, Y.M., Abdilwahid, R.T., Muzakir, S.K., and Kadir, M.F.Z., 2020, Glycerolized Li<sup>+</sup> ion conducting Chitosan-Based Polymer Electrolyte for Energy Storage EDLC Device Applications with Relatively High Energy Density, *Polymers (Basel)*, 12, 1433.
- Atego, E., Agumba, J.O., and Barasa, G.O., 2022, The Signatures of Acid Concentration on the Optical Band Gap and Associated Band Tails of Chitosan from Shrimp for Application in Optoelectronic Devices, *Adv. Chem. Eng. Sci.*, 12, 1–12.
- Aziz, M.F.A., Safie, N.E., Azam, M.A., Adaham, T.A.I.T., Yu, T.J., and Takasaki,



- A., 2022, A Comprehensive Review of Filler, Plasticizer, and Ionic Liquid as An Additive in GPE For DSSCs, *AIMS Energy*, 10, 1122–1145.
- Aziz, S.B., Abdullah, O.G., Rasheed, M.A., and Ahmed, H.M., 2017, Effect of High Salt Concentration (HSC) on Structural, Morphological, and Electrical Characteristics of Chitosan Based Solid Polymer Electrolytes, *Polymers (Basel)*, 9, 1–19.
- Bashal, A.H., Riyadh, S.M., Alharbi, W., Alharbi, K.H., Farghaly, T.A., and Khalil, K.D., 2022, Bio-Based (Chitosan-ZnO) Nanocomposite: Synthesis, Characterization, and Its Use as Recyclable, Ecofriendly Biocatalyst for Synthesis of Thiazoles Tethered Azo Groups, *Polymers (Basel)*, 14, 1–10.
- Batalioto, F., Figueiredo Neto, A.M., and Barbero, G., 2019, Random Energy Barrier Model for AC Electrode Conductivity, *J. Phys. Chem. C*, 123, 6650–6654.
- Bella, F., Galliano, S., Falco, M., Viscardi, G., Barolo, C., Grätzel, M., and Gerbaldi, C., 2016, Unveiling Iodine-Based Electrolytes Chemistry in Aqueous Dye-Sensitized Solar Cells, *Chem. Sci.*, 7, 4880–4890.
- Benny, A., Ramakrishnan, R., and Hariharan, M., 2021, Mutually Exclusive Hole and Electron Transfer Coupling in Cross Stacked Acenes, *Chem. Sci.*, 12, 5064–5072.
- Benramache, S., Belahssen, O., Guettaf, A., and Arif, A., 2013, Correlation Between Electrical Conductivity-Optical Band Gap Energy and Precursor Molarities Ultrasonic Spray Deposition of ZnO Thin Films, *J. Semicond.*, 34, 113001.
- Beygisangchin, M., Rashid, S.A., Shafie, S., Sadrolhosseini, A.R., and Lim, H.N., 2021, Preparations, Properties, and Applications of Polyaniline and Polyaniline Thin Films—A Review, *Polymers (Basel)*, 13, 1–46.
- Bian, X., Kim, C., and Karniadakis, G.E., 2016a, 111 Years of Brownian Motion, *Soft Matter*, 12, 6331–6346.
- Bian, Z., Zhu, J., and Li, H., 2016b, Solvothermal Alcoholysis Synthesis of Hierarchical TiO<sub>2</sub> with Enhanced Activity in Environmental and Energy Photocatalysis, *J. Photochem. Photobiol. C Photochem. Rev.*, 28, 72–86.
- Bisquert, J., Zaban, A., Greenshtein, M., and Mora-Seró, I., 2004, Determination of Rate Constants for Charge Transfer and the Distribution of Semiconductor and Electrolyte Electronic Energy Levels in Dye-Sensitized Solar Cells by Open-Circuit Photovoltage Decay Method, *J. Am. Chem. Soc.*, 126, 13550–13559.
- Bogdan, M., Brugger, D., Rosenstiel, W., and Speiser, B., 2014, Estimation of Diffusion Coefficients from Voltammetric Signals by Support Vector and Gaussian Process Regression, *J. Cheminform.*, 6, 1–13.
- Borbón, S., Lugo, S., Pourjafari, D., Pineda Aguilar, N., Oskam, G., and López, I., 2020, Open-Circuit Voltage (V<sub>oc</sub>) Enhancement in TiO<sub>2</sub>-Based DSSCs: Incorporation of ZnO Nanoflowers and Au Nanoparticles, *ACS Omega*, 5, 10977–10986.
- Boschloo, G. and Hagfeldt, A., 2009, Characteristics of the Iodide/Triiodide Redox Mediator in Dye-Sensitized Solar Cells, *Acc. Chem. Res.*, 42, 1819–1826.
- Buraidah, M.H., Shah, S., Teo, L.P., Chowdhury, F.I., Careem, M.A., Albinsson, I.,



- Mellander, B.E., and Arof, A.K., 2017, High Efficient Dye-Sensitized Solar Cells Using phthaloylchitosan Based Gel Polymer Electrolytes, *Electrochim. Acta*, 245, 846–853.
- Chal, P., Shit, A., and Nandi, A.K., 2016, Dye-Sensitized Solar Cell from a New Organic n-Type Semiconductor/Polyaniline Composite: Insight from Impedance Spectroscopy, *J. Mater. Chem. C*, 4, 272–285.
- Chalkias, D.A., Verykokkos, N.E., Kollia, E., Petala, A., Kostopoulos, V., and Papanicolaou, G.C., 2021, High-Efficiency Quasi-Solid-State Dye-Sensitized Solar Cells Using a Polymer Blend Electrolyte with “Polymer-In-Salt” Conduction Characteristics, *Sol. Energy*, 222, 35–47.
- Chang, W.C., Sie, S.Y., Yu, W.C., Lin, L.Y., and Yu, Y.J., 2016, Preparation of Nano-composite Gel Electrolytes with Metal Oxide Additives for Dye-Sensitized Solar Cells, *Electrochim. Acta*, 212, 333–342.
- Chang, Z., Yang, H., Zhu, X., He, P., and Zhou, H., 2022, A Stable Quasi-Solid Electrolyte Improves the Safe Operation of Highly Efficient Lithium-Metal Pouch Cells in Harsh Environments, *Nat. Commun.*, 13, 1–12.
- Chen-Yang, Y.W., Chen, Y.T., Chen, H.C., Lin, W.T., and Tsai, C.H., 2009, Effect of the Addition of Hydrophobic Clay on the Electrochemical Property of Polyacrylonitrile/LiClO<sub>4</sub> Polymer Electrolytes for Lithium Battery, *Polymer (Guildf.)*, 50, 2856–2862.
- Cho, S.J., Jung, G.Y., Kim, S.H., Jang, M., Yang, D.K., Kwak, S.K., and Lee, S.Y., 2019, Monolithic Heterojunction Quasi-Solid-State Battery Electrolytes Based on Thermodynamically Immiscible Dual Phases, *Energy Environ. Sci.*, 12, 559–565.
- COD, 2023, Index of /cod/archives/2023/PANalytical, *Malvern PANalytical*, 1.
- Daeneke, T., Mozer, A.J., Kwon, T.H., Duffy, N.W., Holmes, A.B., Bach, U., and Spiccia, L., 2012, Dye Regeneration and Charge Recombination in Dye-Sensitized Solar Cells with Ferrocene Derivatives as Redox Mediators, *Energy Environ. Sci.*, 5, 7090–7099.
- Daghrir, R., Drogui, P., and Robert, D., 2013, Modified TiO<sub>2</sub> for Environmental Photocatalytic Applications: A Review, *Ind. Eng. Chem. Res.*, 52, 3581–3599.
- Daoud, A., Cheknane, A., Meftah, A., Michel Nunzi, J., Shalabi, M., and Hilal, H.S., 2022, Spatial Separation Strategies to Control Charge Recombination and Dye Regeneration in p-Type Dye-Sensitized Solar Cells, *Sol. Energy*, 236, 107–152.
- Dayan, O., Özdemir, N., Yakuphanoglu, F., Şerbetci, Z., Bilici, A., Çetinkaya, B., and Tercan, M., 2018, Synthesis and Photovoltaic Properties of New Ru(II) Complexes for Dye-Sensitized Solar Cells, *J. Mater. Sci. Mater. Electron.*, 29, 11045–11058.
- Degen, T., Sadki, M., Bron, E., König, U., and Nénert, G., 2014, The HighScore Suite, *Powder Diffr.*, 29, S13–S18.
- Diantoro, M., Masrul, M.Z., and Taufiq, A., 2018, Effect of TiO<sub>2</sub> Nanoparticles on Conductivity and Thermal Stability of PANI-TiO<sub>2</sub>/Glass Composite Film Effect of TiO<sub>2</sub> Nanoparticles on Conductivity and Thermal Stability of PANI-TiO<sub>2</sub>/Glass Composite Film, *J. Phys. Conf. Ser.*, 1011, 012065.



- Du, B.W., Hu, S.Y., Singh, R., Tsai, T.T., Lin, C.C., and Ko, F.H., 2017, Eco-friendly and Biodegradable Biopolymer Chitosan/Y<sub>2</sub>O<sub>3</sub> Composite Materials in Flexible Organic Thin-film Transistors, *Materials (Basel.)*, 10, 1–9.
- Ehsani, A., Parsimehr, H., Nourmohammadi, H., Safari, R., and Doostikhah, S., 2019, Environment-friendly Electrodes Using Biopolymer Chitosan/Polyorthoaminophenol with Enhanced Electrochemical Behavior for use in Energy Storage Devices, *Polym. Compos.*, 40, 4629–4637.
- Enderton, H.B., 1977, Introduction,. In, *Elements of Set Theory*. Academic Press, pp. 1–16.
- Farag, A.A.M., Osiris, W.G., and Ammar, A.H., 2012, Enhancement of Photovoltaic Characteristics of Nanocrystalline 2,3-Naphthalocyanine Thin-film Based Organic Devices, *Appl. Surf. Sci.*, 259, 600–609.
- Fonseca-Cervantes, O.R., Pérez-Larios, A., Romero Arellano, V.H., Sulbaran-Rangel, B., and González, C.A.G., 2020, Effects in Band Gap for Photocatalysis support by Adding Gold and Ruthenium, *Processes*, 8, 1032.
- Gnida, P., Jarka, P., Chulkin, P., Drygala, A., Libera, M., Tański, T., and Schab-Balcerzak, E., 2021, Impact of TiO<sub>2</sub> Nanostructures on Dye-Sensitized Solar Cells Performance, *Materials (Basel.)*, 14, 1633.
- Goel, M., Siegert, M., Krauss, G., Mohanraj, J., Hochgesang, A., Heinrich, D.C., Fried, M., Pflaum, J., and Thelakkat, M., 2020, HOMO–HOMO Electron Transfer: An Elegant Strategy for p-Type Doping of Polymer Semiconductors toward Thermoelectric Applications, *Adv. Mater.*, 32, 1–7.
- Gong, J., Sumathy, K., and Liang, J., 2012, Polymer Electrolyte Based on Polyethylene Glycol for Quasi-Solid-State Dye-Sensitized Solar Cells, *Renew. Energy*, 39, 419–423.
- Gong, J., Sumathy, K., Qiao, Q., and Zhou, Z., 2017, Review on Dye-Sensitized Solar Cells (DSSCs): Advanced Techniques and Research Trends, *Renew. Sustain. Energy Rev.*, 68, 234–246.
- González-Meza, O.A., Larios-Durán, E.R., Gutiérrez-Becerra, A., Casillas, N., Escalante, J.I., and Bárcena-Soto, M., 2019, Development of a Randles-Ševčík-like Equation to predict the Peak Current of Cyclic Voltammetry for Solid Metal Hexacyanoferrates, *J. Solid State Electrochem.*, 23, 3123–3133.
- González, J., Laborda, E., and Molina, Á., 2023, Voltammetric Kinetic Studies of Electrode Reactions: Guidelines for Detailed Understanding of Their Fundamentals, *J. Chem. Educ.*, 100, 697–706.
- Goto, H., 2014, Novel Function of Polyaniline for Biological Environments: Cultivation of Paramecium in The Presence of Polyaniline, *IOP Conf. Ser. Mater. Sci. Eng.*, 54, 012024.
- Grabowska, E., Diak, M., Marchelek, M., and Zaleska, A., 2014, Decahedral TiO<sub>2</sub> with Exposed Facets: Synthesis, Properties, Photoactivity and Applications, *Appl. Catal. B Environ.*, 156–157, 213–235.
- Gu, D.M., Zhang, J.Z., Zhang, M., Geng, Y., and Su, Z.M., 2016, Dye Regeneration Mechanisms of Dye Sensitized Solar Cells: Quantum Chemical Studies on The Interaction Between Iodide and O/S-Containing Organic Dyes, *Dye. Pigment.*, 132, 136–141.



- Gu, P., Yang, D., Zhu, X., Sun, H., Wangyang, P., Li, J., and Tian, H., 2017, Influence of Electrolyte Proportion on The Performance of Dye-Sensitized Solar Cells, *AIP Adv.*, 7, 105219.
- Gudowska-Nowak, E., Oliveira, F.A., and Wio, H.S., 2022, Editorial: The Fluctuation-Dissipation Theorem Today, *Front. Phys.*, 10, 1–4.
- Gully, T.A., Voßnacker, P., Schmid, J.R., Beckers, H., and Riedel, S., 2021, Conductivity and Redox Potentials of Ionic Liquid Trihalogen Monoanions [X<sub>3</sub>]<sup>-</sup>, [XY<sub>2</sub>]<sup>-</sup>, and [BrF<sub>4</sub>]<sup>-</sup> (X=Cl, Br, I and Y=Cl, Br), *ChemistryOpen*, 10, 255–264.
- Guo, S., Qin, L., Hu, C., Li, L., Luo, Z., Fang, G., and Liang, S., 2022, Quasi-Solid Electrolyte Design and In Situ Construction of Dual Electrolyte/Electrode Interphases for High-Stability Zinc Metal Battery, *Adv. Energy Mater.*, 12, 2200730.
- Gupta, T., Samriti, Cho, J., and Prakash, J., 2021, Hydrothermal Synthesis of TiO<sub>2</sub> Nanorods: Formation Chemistry, Growth Mechanism, and Tailoring of Surface Properties for Photocatalytic Activities, *Mater. Today Chem.*, 20, 100428.
- Harrington, G.F. and Santiso, J., 2021, Back-to-Basics Tutorial: X-ray Diffraction of Thin films, *J. Electroceramics*, 47, 141–163.
- Harris, J., Silk, R., Smith, M., Dong, Y., Chen, W.T., and Waterhouse, G.I.N., 2020, Hierarchical TiO<sub>2</sub> Nanoflower Photocatalysts with Remarkable Activity for Aqueous Methylene Blue Photo-Oxidation, *ACS Omega*, 5, 18919–18934.
- Hatmanto, A.D., 2012, Gel Elektrolit Berbasis Kitosan Sebagai Elektrolit Redoks Semipadat dalam Sel Surya Tersensitasi Zat Warna, *Skripsi*, FMIPA UGM, Yogyakarta.
- Heng, L., Wang, X., Yang, N., Zhai, J., Wan, M., and Jiang, L., 2010, p-n Junction Based Flexible Dye-Sensitized Solar Cells, *Adv. Funct. Mater.*, 20, 266–271.
- Hussein, E.M., Desoky, W.M., Hanafy, M.F., and Guirguis, O.W., 2021, Effect of TiO<sub>2</sub> Nanoparticles on The Structural Configurations and Thermal, Mechanical, and Optical Properties of Chitosan/TiO<sub>2</sub> Nanoparticle Composites, *J. Phys. Chem. Solids*, 152, 109983.
- Huyen, D.N., Tung, N.T., Thien, N.D., and Le Thanh, H., 2011, Effect of TiO<sub>2</sub> on The Gas Sensing Features of TiO<sub>2</sub>/PANi Nanocomposites, *Sensors*, 11, 1924–1931.
- Iftikhar, H., Sonai, G.G., Hashmi, S.G., Nogueira, A.F., and Lund, P.D., 2019, Progress on Electrolytes Development in Dye-Sensitized Solar Cells, *Materials (Basel)*, 12, 1–68.
- Kamarudin, S., Rani, M.S.A., Mohammad, M., Mohammed, N.H., Su'ait, M.S., Ibrahim, M.A., Asim, N., and Razali, H., 2021, Investigation on Size and Conductivity of Polyaniline Nanofiber Synthesised by Surfactant-free Polymerization, *J. Mater. Res. Technol.*, 14, 255–261.
- Kashif, M.K., Axelson, J.C., Duffy, N.W., Forsyth, C.M., Chang, C.J., Long, J.R., Spiccia, L., and Bach, U., 2012, A New Direction in Dye-Sensitized Solar Cells Redox Mediator Development: In Situ Fine-Tuning of The Cobalt(II)/(III) Redox Potential Through Lewis Base Interactions, *J. Am. Chem. Soc.*, 134, 16646–16653.



- Kobayashi, Y., Yoshida, S., Sakurada, R., Takashima, K., Yamamoto, T., Saito, T., Konabe, S., Taniguchi, T., Watanabe, K., Maniwa, Y., Takeuchi, O., Shigekawa, H., and Miyata, Y., 2016, Modulation of Electrical Potential and Conductivity in an Atomic-Layer Semiconductor Heterojunction, *Sci. Rep.*, 6, 1–8.
- Kocyigit, A., Yilmaz, M., Aydogan, S., Incekara, U., and Sahin, Y., 2020, The Performance of Chitosan Layer in Au/N-Si Sandwich Structures as a Barrier Modifier, *Polym. Test.*, 89, 106546.
- Koiki, B.A., Orimolade, B.O., Zwane, B.N., Nkwachukwu, O. V., Muzenda, C., Nkosi, D., and Arotiba, O.A., 2021, The Application of FTO-Cu<sub>2</sub>O/Ag<sub>3</sub>PO<sub>4</sub> Heterojunction in The Photoelectrochemical Degradation of Emerging Pharmaceutical Pollutant Under Visible Light Irradiation, *Chemosphere*, 266, 129231.
- Krakowiak, R., Musial, J., Bakun, P., Spychała, M., Czarczynska-Goslinska, B., Mlynarczyk, D.T., Koczorowski, T., Sobotta, L., Stanisz, B., and Goslinski, T., 2021, Titanium Dioxide-based Photocatalysts for Degradation of Emerging Contaminants Including Pharmaceutical Pollutants, *Appl. Sci.*, 11, 2–32.
- Kubo, W., Makimoto, Y., Kitamura, T., Wada, Y., and Yanagida, S., 2002, Quasi-Solid-State Dye-Sensitized Solar Cell with Ionic Polymer Electrolyte, *Chem. Lett.*, 948–949.
- Kumari, J.M.K.W., Senadeera, G.K.R., Weerasinghe, A.M.J.S., Thotawatthage, C.A., and Dissanayake, M.A.K.L., 2021, Effect of Polyaniline (PANI) on Efficiency Enhancement of Dye-Sensitized Solar Cells Fabricated with poly(ethylene oxide)-based Gel Polymer Electrolytes, *J. Solid State Electrochem.*, 25, 695–705.
- Lee, D.H., Lee, M.J., Song, H.M., Song, B.J., Seo, K.D., Pastore, M., Anselmi, C., Fantacci, S., De Angelis, F., Nazeeruddin, M.K., Gretzel, M., and Kim, H.K., 2011, Organic Dyes Incorporating Low-band-gap Chromophores based on π-extended Benzothiadiazole for Dye-Sensitized Solar Cells, *Dye. Pigment.*, 91, 192–198.
- Lee, Y.L., Shen, Y.J., and Yang, Y.M., 2008, A hybrid PVDF-HFP/nanoparticle gel electrolyte for dye-sensitized solar cell applications, *Nanotechnology*, 19, 455201.
- Li, L., Yang, Y., Fan, R., Chen, S., Wang, P., Yang, B., and Cao, W., 2014, Conductive Upconversion Er,Yb-FTO Nanoparticle Coating to Replace Pt as a Low-Cost and High-Performance Counter Electrode for Dye-Sensitized Solar Cells, *ACS Appl. Mater. Interfaces*, 6, 8223–8229.
- Li, X., Wang, Y., Xi, K., Yu, W., Feng, J., Gao, G., Wu, H., Jiang, Q., Abdelkader, A., Hua, W., Zhong, G., and Ding, S., 2022, Quasi-Solid-State Ion-Conducting Arrays Composite Electrolytes with Fast Ion Transport Vertical-Aligned Interfaces for All-Weather Practical Lithium-Metal Batteries, *Nano-Micro Lett.*, 14, 1–14.
- Liang, C.J. and Li, J.Y., 2019, Recovery of gold in iodine-iodide system—a review, *Sep. Sci. Technol.*, 54, 1055–1066.
- Liao, J.Y., He, J.W., Xu, H., Kuang, D. Bin, and Su, C.Y., 2012, Effect of TiO<sub>2</sub>



- Morphology on Photovoltaic Performance of Dye-Sensitized Solar Cells: Nanoparticles, Nanofibers, Hierarchical Spheres and Ellipsoid spheres, *J. Mater. Chem.*, 22, 7910–7918.
- Liao, X., Li, T.T., Ren, H.T., Zhang, X., Shen, B., Lin, J.H., and Lou, C.W., 2022, Construction of Bio<sub>1</sub>/TiO<sub>2</sub> Flexible and Hierarchical S-Scheme Heterojunction Nanofibers Membranes for Visible-Light-Driven Photocatalytic Pollutants Degradation, *Sci. Total Environ.*, 806, 1–10.
- Lim, S.M., Moon, J., Baek, U.C., Lee, J.Y., Chae, Y., and Park, J.T., 2021, Shape-controlled TiO<sub>2</sub> Nanomaterials-based Hybrid Solid-State Electrolytes for Solar Energy Conversion with a Mesoporous Carbon Electrocatalyst, *Nanomaterials*, 11, 913.
- Liow, K.S., Sipaut, C.S., and Jafarzadeh, M., 2018, Polypyrrole- and Polyaniline-surface Modified Nanosilica as Quasi-Solid-State Electrolyte Ingredients for Dye-Sensitized Solar Cells, *J. Mater. Sci. Mater. Electron.*, 29, 21097–21108.
- Liu, D., Li, C., Zhou, F., Zhang, T., Zhang, H., Li, X., Duan, G., Cai, W., and Li, Y., 2015, Rapid Synthesis of Monodisperse Au Nanospheres through a Laser Irradiation-Induced Shape Conversion, Self-Assembly and Their Electromagnetic Coupling SERS Enhancement, *Sci. Rep.*, 5, .
- Liu, Z., Zein El Abedin, S., and Endres, F., 2014, Electrodeposition and Stripping of Zinc from an Ionic Liquid Polymer Gel Electrolyte For Rechargeable Zinc-based Batteries, *J. Solid State Electrochem.*, 18, 2683–2691.
- Luttrell, T., Halpegamage, S., Tao, J., Kramer, A., Sutter, E., and Batzill, M., 2015, Why is Anatase a Better Photocatalyst than Rutile? - Model Studies on Epitaxial TiO<sub>2</sub> Films, *Sci. Rep.*, 4, 1–8.
- MacFarlane, D.R., Forsyth, M., Izgorodina, E.I., Abbott, A.P., Annat, G., and Fraser, K., 2009, On The Concept of Ionicity in Ionic Liquids, *Phys. Chem. Chem. Phys.*, 11, 4962–4967.
- Makori, N.E., Oeba, D.A., and Mosiori, C., 2017, Relationship between Band Gap and Particle Size of Cadmium Sulfide Quantum Dots, *Chem. Res. J.*, 2, 15–21.
- Makuła, P., Pacia, M., and Macyk, W., 2018, How To Correctly Determine the Band Gap Energy of Modified Semiconductor Photocatalysts Based on UV-Vis Spectra, *J. Phys. Chem. Lett.*, 9, 6814–6817.
- Mandal, S., Rao, S., and Ramanujam, K., 2017, Understanding the Photo-Electrochemistry of Metal-free di and tri Substituted Thiophene-based Organic Dyes in Dye-Sensitized Solar Cells using DFT/TD-DFT Studies, *Ionics (Kiel)*, 23, 3545–3554.
- Mansoor, R.D. and Rasheed, L.M., 2019, A study on the conductivity of polyaniline polymers, *IOP Conf. Ser. Mater. Sci. Eng.*, 571, 012087.
- Marroquin, J.B., Rhee, K.Y., and Park, S.J., 2013, Chitosan Nanocomposite Films: Enhanced Electrical Conductivity, Thermal Stability, and Mechanical Properties, *Carbohydr. Polym.*, 92, 1783–1791.
- Masud, N. and Kim, H.K., 2023, Redox Shuttle-Based Electrolytes for Dye-Sensitized Solar Cells: Comprehensive Guidance, Recent Progress, and Future Perspective, *ACS Omega*, 8, 6139–6163.



- Metze, F.K., Sant, S., Meng, Z., Klok, H.A., and Kaur, K., 2023, Swelling-Activated, Soft Mechanochemistry in Polymer Materials, *Langmuir*, 39, 3546–3557.
- Mohamad, A.A., 2016, Absorbency and Conductivity of Quasi-Solid-State Polymer Electrolytes for Dye-Sensitized Solar Cells: A Characterization Review, *J. Power Sources*, 329, 57–71.
- Momma, K. and Izumi, F., 2008, VESTA: A Three-dimensional Visualization System for Electronic and Structural Analysis, *J. Appl. Crystallogr.*, 41, 653–658.
- Moreau, L.M., Ha, D.H., Zhang, H., Hovden, R., Muller, D.A., and Robinson, R.D., 2013, Defining Crystalline/Amorphous phases of Nanoparticles through X-Ray Absorption Spectroscopy and X-Ray Diffraction: The Case of Nickel Phosphide, *Chem. Mater.*, 25, 2394–2403.
- Muhammad, F.H., Subban, R.H.Y., and Winie, T., 2019, Solid Solutions of Hexanoyl Chitosan/poly(Vinyl Chloride) Blends and NaI for All-Solid-State Dye-Sensitized Solar Cells, *Ionics (Kiel)*, 25, 3373–3386.
- Mustapha, S., Ndamitso, M.M., Abdulkareem, A.S., Tijani, J.O., Shuaib, D.T., Ajala, A.O., and Mohammed, A.K., 2020, Application of TiO<sub>2</sub> and ZnO Nanoparticles Immobilized on Clay in Wastewater Treatment: A Review, *Appl. Water Sci.*, 10, 1–36.
- Nanda, K.K., 2012, Size-Dependent Density of Nanoparticles and Nanostructured Materials, *Phys. Lett. Sect. A Gen. At. Solid State Phys.*, 376, 3301–3302.
- Ng, H.M., Ramesh, S., and Ramesh, K., 2015, Efficiency Improvement by Incorporating 1-methyl-3-propylimidazolium Iodide Ionic Liquid in Gel Polymer Electrolytes for Dye-Sensitized Solar Cells, *Electrochim. Acta*, 175, 169–175.
- Nicholson, R.S. and Shain, I., 1964, Correction: Theory of Stationary Electrode Polarography: Single Scan and Cyclic Methods Applied to Reversible, Irreversible, and Kinetic Systems, *Anal. Chem.*, 36, 1212.
- Othman, M.A., Amat, N.F., Ahmad, B.H., and Rajan, J., 2014, Electrical Conductivity Characteristic of TiO<sub>2</sub> Nanowires from Hydrothermal Method, *J. Phys. Conf. Ser.*, 495, 012027.
- Pardo-Castaño, C. and Bolaños, G., 2019, Solubility of Chitosan in Aqueous Acetic Acid and Pressurized Carbon Dioxide-Water: Experimental Equilibrium and Solubilization Kinetics, *J. Supercrit. Fluids*, 151, 63–74.
- Parlane, F.G.L., Mustoe, C., Kellett, C.W., Simon, S.J., Swords, W.B., Meyer, G.J., Kennepohl, P., and Berlinguette, C.P., 2017, Spectroscopic Detection of Halogen Bonding Resolves Dye Regeneration in The Dye-Sensitized Solar Cell, *Nat. Commun.*, 8, 1–7.
- Popov, I., Zhu, Z., Young-Gonzales, A.R., Sacci, R.L., Mamontov, E., Gainaru, C., Paddison, S.J., and Sokolov, A.P., 2023, Search For a Grotthuss Mechanism Through the Observation of Proton Transfer, *Commun. Chem.*, 6, 1–10.
- Porebska, R., Rybak, A., Kozub, B., and Sekula, R., 2015, Polymer Matrix Influence on Stability of Wood Polymer Composites, *Polym. Adv. Technol.*, 26, 1076–1082.
- Portillo-Cortez, K., Martínez, A., Dutt, A., and Santana, G., 2019, N719 Derivatives



- for Application in a Dye-Sensitized Solar Cell (DSSC): A Theoretical Study, *J. Phys. Chem. A*, 123, 10930–10939.
- Pratiwi, D.D., Nurosyid, F., Kusumandari, Supriyanto, A., and Suryana, R., 2017, Performance Improvement of Dye-Sensitized Solar Cells (DSSC) by Using Dyes Mixture from Chlorophyll and Anthocyanin, *J. Phys. Conf. Ser.*, 909, 2–6.
- Pullanjiot, N. and Swaminathan, S., 2019, Enhanced Electrochemical Properties of Metal Oxide Interspersed Polymer Gel Electrolyte for QSDSSC Application, *Sol. Energy*, 186, 37–45.
- Rahman, S.U., Bilal, S., and Ali Shah, A.U.H., 2020, Synthesis and Characterization of Polyaniline-Chitosan Patches with Enhanced Stability in Physiological Conditions, *Polymers (Basel)*, 12, 1–13.
- Ramos, A., Lasso, E., Prakash, S., Paranthaman, S., and Gomez, E.A., 2018, Studies on the Structure and Electronic Properties of Linear Chitosan-Silver Nano-Composite for Biosensor Applications, *IEEE Third ETM*.,
- Randviir, E.P., 2018, A Cross Examination of Electron Transfer Rate Constants for Carbon Screen-Printed Electrodes Using Electrochemical Impedance Spectroscopy and Cyclic Voltammetry, *Electrochim. Acta*, 286, 179–186.
- Rased, N.H., Raihan, S.R.S., and Rahim, N.A., 2021, P(HEMA-co-EA) as Host Polymer for Flexible Dye-Sensitized Solar Cell (DSSC) Electrolyte, *IOP Conf. Ser. Mater. Sci. Eng.*, 1127, 012042.
- Rathore, B.S., Chauhan, N.P.S., Rawal, M.K., Ameta, S.C., and Ameta, R., 2020, Chitosan–Polyaniline–Copper(II) Oxide Hybrid Composite for the Removal of Methyl Orange Dye, *Polym. Bull.*, 77, 4833–4850.
- Ratuchne, F., Danczuk, M., and Castro, E.G., 2018, Enhanced Stability and Conductivity of (polyaniline-chitosan) Composites, *Orbital Electron. J. Chem.*, 10, 1–8.
- Reza, M., Steky, F.V., and Suendo, V., 2020, Effect of Acid Doping on Junction Characteristics of ITO/Polyaniline/N719/Ag Diode, *J. Electron. Mater.*, 49, 1835–1840.
- Ri, J.H., Wu, S., Jin, J., and Peng, T., 2017, Growth of a Sea Urchin-Like Rutile TiO<sub>2</sub> Hierarchical Microsphere Film on Ti Foil for a Quasi-Solid-State Dye-Sensitized Solar Cell, *Nanoscale*, 9, 18498–18506.
- Roling, B., 2002, Conductivity Spectra of Disordered Ionic Conductors : Calculating the Time-Dependent Mean Square Displacement of the Mobile Ions Introduction, *Dielectr. News*., 1–8.
- Şahin, Z., Meunier-Prest, R., Dumoulin, F., Kumar, A., Isci, Ü., and Bouvet, M., 2021, Tuning of Organic Heterojunction Conductivity by The Substituents' Electronic Effects in Phthalocyanines for Ambipolar Gas Sensors, *Sensors Actuators, B Chem.*, 332, 129505.
- Saidi, N.M., Omar, F.S., Numan, A., Apperley, D.C., Algaradah, M.M., Kasi, R., Avestro, A.J., and Subramaniam, R.T., 2019, Enhancing the Efficiency of a Dye-Sensitized Solar Cell Based on a Metal Oxide Nanocomposite Gel Polymer Electrolyte, *ACS Appl. Mater. Interfaces*, 11, 30185–30196.
- Salman, Y.A.K., Abdullah, O.G., Hanna, R.R., and Aziz, S.B., 2018, Conductivity and Electrical Properties of Chitosan-methylcellulose Blend Biopolymer



- Electrolyte Incorporated with Lithium Tetrafluoroborate, *Int. J. Electrochem. Sci.*, 13, 3185–3199.
- Schmidt, J.V. and Venturi, G., 2023, Axioms and Postulates as Speech Acts, *Erkenntnis*, 1–13.
- Schneider, C.A., Rasband, W.S., and Eliceiri, K.W., 2012, NIH Image to ImageJ: 25 Years of Image Analysis, *Nat. Methods*, 9, 671–675.
- Schrøder, T.B. and Dyre, J.C., 2020, Solid-like Mean-square Displacement in Glass-forming Liquids, *J. Chem. Phys.*, 152, 1–6.
- Shah, S., Baharun, N.N.S., Yusuf, S.N.F., and Arof, A.K., 2019, Efficiency Enhancement of Dye-Sensitized Solar Cells (DSSCs) using Copper Nanopowder (CuNW) in TiO<sub>2</sub> as Photoanode, *IOP Conf. Ser. Mater. Sci. Eng.*, 515, .
- Sienkiewicz, A., Krasucka, P., Charmas, B., Stefaniak, W., and Goworek, J., 2017, Swelling Effects in Cross-linked Polymers by Thermogravimetry, *J. Therm. Anal. Calorim.*, 130, 85–93.
- Singh, P.K., Bhattacharya, B., and Nagarale, R.K., 2010, Effect of Nano-TiO<sub>2</sub> Dispersion on PEO Polymer Electrolyte Property, *J. Appl. Polym. Sci.*, 118, 2976–2980.
- Sinha, D., De, D., Goswami, D., Mondal, A., and Ayaz, A., 2019, ZnO and TiO<sub>2</sub> Nanostructured Dye Sensitized Solar Photovoltaic Cell, *Mater. Today Proc.*, 11, 782–788.
- Siripatrawan, U. and Kaewklin, P., 2018, Fabrication and Characterization of Chitosan-Titanium Dioxide Nanocomposite Film as Ethylene Scavenging and Antimicrobial Active Food Packaging, *Food Hydrocoll.*, 84, 125–134.
- Suriani, A.B., Muqooyyah, Mohamed, A., Mamat, M.H., Hashim, N., Isa, I.M., Malek, M.F., Kairi, M.I., Mohamed, A.R., and Ahmad, M.K., 2018, Improving The Photovoltaic Performance of DSSCs Using a Combination of Mixed-Phase TiO<sub>2</sub> Nanostructure Photoanode and Agglomerated Free Reduced Graphene Oxide Counter Electrode Assisted with Hyperbranched Surfactant, *Optik (Stuttg.)*, 158, 522–534.
- Tang, Z., Liu, Q., Tang, Q., Wu, J., Wang, J., Chen, S., Cheng, C., Yu, H., Lan, Z., Lin, J., and Huang, M., 2011, Preparation of PAA-g-CTAB/PANI Polymer Based Gel-Electrolyte and The Application in Quasi-Solid-State Dye-Sensitized Solar Cells, *Electrochim. Acta*, 58, 52–57.
- Wang, R.X., Huang, L.F., and Tian, X.Y., 2012, Understanding the protonation of polyaniline and polyaniline-graphene interaction, *J. Phys. Chem. C*, 116, 13120–13126.
- Watanabe, N., 2021, support/potentiostat/Redox Potential - III | ALS,the electrochemical company, *Electrochem. Spectroelectrochemistry*, 1.
- Wattanavichean, N., Casey, E., Nichols, R.J., and Arnolds, H., 2018, Discrimination Between Hydrogen Bonding and Protonation in The Spectra of a Surface-Enhanced Raman Sensor, *Phys. Chem. Chem. Phys.*, 20, 866–871.
- Wu, J., Lan, Z., Lin, J., Huang, M., Huang, Y., Fan, L., and Luo, G., 2015, Electrolytes in Dye-Sensitized Solar Cells, *Chem. Rev.*, 115, 2136–2173.
- Xu, M., Gao, Y., Moreno, E.M., Kunst, M., Muhler, M., Wang, Y., Idriss, H., and



- Wöll, C., 2011, Discrimination Between Hydrogen Bonding and Protonation in The Spectra of a Surface-Enhanced Raman Sensor Photocatalytic Activity of Bulk TiO<sub>2</sub> Anatase and Rutile Single Crystals Using Infrared Absorption Spectroscopy, *Phys. Rev. Lett.*, 106, 138302.
- Xu, Q., Zhang, L., Cheng, B., Fan, J., and Yu, J., 2020, S-Scheme Heterojunction Photocatalyst, *Chem.*, 6, 1543–1559.
- Xu, X., Xu, Y., Zhang, J., Zhong, Y., Li, Z., Qiu, H., Wu, H. Bin, Wang, J., Wang, X., Gu, C., and Tu, J., 2023, Quasi-Solid Electrolyte Interphase Boosting Charge and Mass Transfer for Dendrite-Free Zinc Battery, *Nano-Micro Lett.*, 15, 1–15.
- Yahya, W.Z.N., Meng, W.T., Khatani, M., Samsudin, A.E., and Mohamed, N.M., 2017, Bio-based Chitosan/PvDF-HFP Polymer-Blend for Quasi-Solid-State Electrolyte Dye-Sensitized Solar Cells, *E-Polymers*, 17, 355–361.
- Yakuphanoglu, F. and Şenkal, B.F., 2007, Electronic and Thermoelectric Properties of Polyaniline Organic Semiconductor and Electrical Characterization of Al/PANI MIS Diode, *J. Phys. Chem. C*, 111, 1840–1846.
- Yamada, H., Yoshii, K., Asahi, M., Chiku, M., and Kitazumi, Y., 2022, Cyclic Voltammetry Part 1: Fundamentals†, *Electrochemistry*, 90, 1–8.
- Yanagida, S., 2006, Recent Research Progress of Dye-Sensitized Solar Cells in Japan, *Comptes Rendus Chim.*, 9, 597–604.
- Ye, C., Cheng, H., Wrede, S., Diring, S., Tian, H., Odobel, F., and Hammarström, L., 2023, Charge Recombination Deceleration by Lateral Transfer of Electrons in Dye-Sensitized NiO Photocathode, *J. Am. Chem. Soc.*, 145, 11067–11073.
- Yoshizawa, K., 2012, An Orbital Rule for Electron Transport in Molecules, *Acc. Chem. Res.*, 45, 1612–1621.
- Yu, Z., 2012, Liquid Redox Electrolytes for Dye-Sensitized Solar Cells, *Doctoral Thesis*, KTH Chemical Science and Engineering, Stockholm.
- Yue, G.T., Wu, J.H., Xiao, Y.M., Ye, H.F., Lin, J.M., and Huang, M.L., 2011, Flexible Dye-Sensitized Solar Cell based on PCBM/P3HT Heterojunction, *Chinese Sci. Bull.*, 56, 325–330.
- Zander, Z., Yagloksi, R., DeCoste, J., Zhang, D., and DeLacy, B.G., 2016, One-pot Synthesis of High Aspect Ratio Titanium Dioxide Nanorods Using Oxalic Acid as A Complexing Agent, *Mater. Lett.*, 163, 39–42.
- Zhang, Jin, Yu, C., Wang, L., Li, Y., Ren, Y., and Shum, K., 2014a, Energy Barrier at the N719-dye/CsSnI<sub>3</sub> Interface for Photogenerated Holes in Dye-Sensitized Solar Cells, *Sci. Rep.*, 4, 1–6.
- Zhang, Jinfeng, Zhou, P., Liu, J., and Yu, J., 2014b, New Understanding of The Difference of Photocatalytic Activity among Anatase, Rutile and Brookite TiO<sub>2</sub>, *Phys. Chem. Chem. Phys.*, 16, 20382–20386.
- Zhang, Y., Yan, Y., Shen, G., and Hong, K., 2022, Synthesis of Type-II Heterojunction Films between ReS<sub>2</sub> and XS<sub>2</sub> (X = Mo,W) with High Electrocatalytic Activities in Dye-Sensitized Solar Cells, *Catal. Commun.*, 170, 106497.
- Zheng, Z., Zu, X., Zhang, Y., and Zhou, W., 2020, Rational Design of type-II Nano-Heterojunctions for Nanoscale Optoelectronics, *Mater. Today Phys.*, 15,



100262.

- Zhu, J., Wang, S., Bian, Z., Xie, S., Cai, C., Wang, J., Yang, H., and Li, H., 2010, Solvothermally Controllable Synthesis of Anatase TiO<sub>2</sub> Nanocrystals with Dominant {001} Facets and Enhanced Photocatalytic Activity, *CrystEngComm*, 12, 2219–2224.
- Ziadon, K.M. and Saadon, W.T., 2012, Study of The Electrical Characteristics of Polyaniline prepared by Electrochemical Polymerization, *Energy Procedia*, 19, 71–79.