References

Anantharaj, S., Ede, S.R., Karthick, K., Sankar, S.S., Sangeetha, K., Karthik, P.E. and Kundu, S., 2018. Precision and correctness in the evaluation of electrocatalytic water splitting: revisiting activity parameters with a critical assessment. *Energy & Environmental Science*, *11*(4), pp.744-771.

Antolini, E., 2014. Iridium as catalyst and cocatalyst for oxygen evolution/reduction in acidic polymer electrolyte membrane electrolyzers and fuel cells. *Acs Catalysis*, *4*(5), pp.1426-1440.

Arantegui, R.L. and Jäger-Waldau, A., 2018. Photovoltaics and wind status in the European Union after the Paris Agreement. *Renewable and Sustainable Energy Reviews*, *81*, pp.2460-2471.

Artyushkova, K., Serov, A., Doan, H., Danilovic, N., Capuano, C.B., Sakamoto, T., Kishi, H., Yamaguchi, S., Mukerjee, S. and Atanassov, P., 2019. Application of X-ray photoelectron spectroscopy to studies of electrodes in fuel cells and electrolyzers. *Journal of Electron Spectroscopy and Related Phenomena*, *231*, pp.127- 139.

Bard, A.J., Faulkner, L.R. and White, H.S., 2022. *Electrochemical methods: fundamentals and applications*. John Wiley & Sons.

Bikkarolla, S.K. and Papakonstantinou, P., 2015. CuCo2O4 nanoparticles on nitrogenated graphene as highly efficient oxygen evolution catalyst. *Journal of Power Sources*, *281*, pp.243-251.

Busch, M., Halck, N.B., Kramm, U.I., Siahrostami, S., Krtil, P. and Rossmeisl, J., 2016. Beyond the top of the volcano?–A unified approach to electrocatalytic oxygen reduction and oxygen evolution. *Nano Energy*, *29*, pp.126-135.

Cao, L.M., Hu, Y.W., Tang, S.F., Iljin, A., Wang, J.W., Zhang, Z.M. and Lu, T.B., 2018. Fe-CoP electrocatalyst derived from a bimetallic Prussian Blue analogue for large-current-density oxygen evolution and overall water splitting. *Advanced science*, *5*(10), p.1800949.

Cao, R., Lai, W. and Du, P., 2012. Catalytic water oxidation at single metal sites. *Energy & Environmental Science*, *5*(8), pp.8134-8157.

Cao, R., Lee, J.S., Liu, M. and Cho, J., 2012. Recent progress in non-precious catalysts for metal-air batteries. *Advanced Energy Materials*, *2*(7), pp.816-829.

Chen, P., Xu, K., Zhou, T., Tong, Y., Wu, J., Cheng, H., Lu, X., Ding, H., Wu, C. and Xie, Y., 2016. Strong-coupled cobalt borate nanosheets/graphene hybrid as electrocatalyst for water oxidation under both alkaline and neutral conditions. *Angewandte Chemie International Edition*, *55*(7), pp.2488-2492.

Chen, P., Zhou, T., Zhang, M., Tong, Y., Zhong, C., Zhang, N., Zhang, L., Wu, C. and Xie, Y., 2017. 3D nitrogen-anion-decorated nickel sulfides for highly efficient overall water splitting. *Advanced Materials*, *29*(30), p.1701584.

Chiu, K.L. and Lin, L.Y., 2019. Applied potential-dependent performance of the nickel cobalt oxysulfide nanotube/nickel molybdenum oxide nanosheet core–shell structure in energy storage and oxygen evolution. *Journal of materials chemistry A*, *7*(9), pp.4626-4639.

Chow, J., Kopp, R.J. and Portney, P.R., 2003. Energy resources and global development. *Science*, *302*(5650), pp.1528-1531.

Cook, T.R., Dogutan, D.K., Reece, S.Y., Surendranath, Y., Teets, T.S. and Nocera, D.G., 2010. Solar energy supply and storage for the legacy and nonlegacy worlds. *Chemical reviews*, *110*(11), pp.6474-6502.

Corma, A., 1997. From microporous to mesoporous molecular sieve materials and their use in catalysis. *Chemical reviews*, *97*(6), pp.2373-2420.

Débart, A., Paterson, A.J., Bao, J. and Bruce, P.G., 2008. α-MnO2 nanowires: a catalyst for the O2 electrode in rechargeable lithium batteries. *Angewandte Chemie International Edition*, *47*(24), pp.4521-4524.

Devaguptapu, S.V., Hwang, S., Karakalos, S., Zhao, S., Gupta, S., Su, D., Xu, H. and Wu, G., 2017. Morphology control of carbon-free spinel NiCo2O4 catalysts for enhanced bifunctional oxygen reduction and evolution in alkaline media. *ACS applied materials & interfaces*, *9*(51), pp.44567-44578.

Ehsan, M.A., Hakeem, A.S., Sharif, M. and Rehman, A., 2019. Direct deposition of amorphous cobalt–vanadium mixed oxide films for electrocatalytic water oxidation. *ACS omega*, *4*(7), pp.12671-12679.

Epp, J., 2016. X-ray diffraction (XRD) techniques for materials characterization. In *Materials characterization using nondestructive evaluation (NDE) methods* (pp. 81-124). Woodhead Publishing.

Ermrich, M. and Opper, D., 2013. *XRD for the analyst: Getting acquainted with the principles*. PANalytical.

Fabbri, E. and Schmidt, T.J., 2018. Oxygen evolution reaction—the enigma in water electrolysis. *Acs Catalysis*, *8*(10), pp.9765-9774.

Fabbri, E., Habereder, A., Waltar, K., Kötz, R. and Schmidt, T.J., 2014. Developments and perspectives of oxide-based catalysts for the oxygen evolution reaction. *Catalysis Science & Technology*, *4*(11), pp.3800-3821.

Fateixa, S., Nogueira, H.I. and Trindade, T., 2018. SERS research applied to polymer based nanocomposites. *Raman Spectroscopy*.

Gao, J., Li, Y., Shi, L., Li, J. and Zhang, G., 2018. Rational design of hierarchical nanotubes through encapsulating CoSe2 nanoparticles into MoSe2/C composite shells with enhanced lithium and sodium storage performance. *ACS applied materials & interfaces*, *10*(24), pp.20635-20642.

Gerken, J.B., McAlpin, J.G., Chen, J.Y., Rigsby, M.L., Casey, W.H., Britt, R.D. and Stahl, S.S., 2011. Electrochemical water oxidation with cobalt-based electrocatalysts from pH 0–14: the thermodynamic basis for catalyst structure, stability, and activity. *Journal of the American Chemical Society*, *133*(36), pp.14431-14442.

Goldstein, J.I., Newbury, D.E., Michael, J.R., Ritchie, N.W., Scott, J.H.J. and Joy, D.C., 2017. *Scanning electron microscopy and X-ray microanalysis*. springer.

Gong, M. and Dai, H., 2015. A mini review of NiFe-based materials as highly active oxygen evolution reaction electrocatalysts. *Nano Research*, *8*, pp.23-39.

Gorlin, Y. and Jaramillo, T.F., 2010. A bifunctional nonprecious metal catalyst for oxygen reduction and water oxidation. *Journal of the American Chemical Society*, *132*(39), pp.13612-13614.

Grimaud, A., May, K.J., Carlton, C.E., Lee, Y.L., Risch, M., Hong, W.T., Zhou, J. and Shao-Horn, Y., 2013. Double perovskites as a family of highly active catalysts for oxygen evolution in alkaline solution. *Nature communications*, *4*(1), p.2439.

Guo, C., Li, Y., Liao, W., Liu, Y., Li, Z., Sun, L., Chen, C., Zhang, J., Si, Y. and Li, L., 2018. Boosting the oxygen reduction activity of a three-dimensional network Co–N–C electrocatalyst via space-confined control of nitrogen-doping efficiency and the molecular-level coordination effect. *Journal of Materials Chemistry A*, *6*(27), pp.13050-13061.

Han, L., Dong, S. and Wang, E., 2016. Transition-metal (Co, Ni, and Fe)-based electrocatalysts for the water oxidation reaction. *Advanced materials*, *28*(42), pp.9266-9291.

Holder, C.F. and Schaak, R.E., 2019. Tutorial on powder X-ray diffraction for characterizing nanoscale materials. *Acs Nano*, *13*(7), pp.7359-7365.

Hu, C., Zhang, L., Zhao, Z.J., Li, A., Chang, X. and Gong, J., 2018. Synergism of geometric construction and electronic regulation: 3D Se-(NiCo) Sx/(OH) x nanosheets for highly efficient overall water splitting. *Advanced Materials*, *30*(12), p.1705538.

Hu, Y., Jensen, J.O., Norby, P., Cleemann, L.N., Yang, F. and Li, Q., 2021. Mechanistic insights into the synthesis of platinum–rare earth metal nanoalloys by a solid-state chemical route. *Chemistry of Materials*, *33*(2), pp.535-546.

Huang, J., Li, Y., Huang, R.K., He, C.T., Gong, L., Hu, Q., Wang, L., Xu, Y.T., Tian, X.Y., Liu, S.Y. and Ye, Z.M., 2018. Electrochemical exfoliation of pillared-layer metal–organic framework to boost the oxygen evolution reaction. *Angewandte Chemie*, *130*(17), pp.4722-4726.

Huang, Z.F., Song, J., Dou, S., Li, X., Wang, J. and Wang, X., 2019. Strategies to break the scaling relation toward enhanced oxygen electrocatalysis. *Matter*, *1*(6), pp.1494-1518.

Inkson, B.J., 2016. Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) for materials characterization. In *Materials characterization using nondestructive evaluation (NDE) methods* (pp. 17-43). Woodhead publishing.

Isaacs, M.A., Davies-Jones, J., Davies, P.R., Guan, S., Lee, R., Morgan, D.J. and Palgrave, R., 2021. Advanced XPS characterization: XPS-based multi-technique analyses for comprehensive understanding of functional materials. *Materials Chemistry Frontiers*, *5*(22), pp.7931-7963.

J. Yang et al., "Bimetallic Palladium-Based Nanocatalysts: From Pd Nanostructures to Pd Heterostructures", Advanced Materials 2019, 31(5), 1804670.

Jia, X., Zhao, Y., Chen, G., Shang, L., Shi, R., Kang, X., Waterhouse, G.I., Wu, L.Z., Tung, C.H. and Zhang, T., 2016. Ni 3 FeN Nanoparticles Derived from Ultrathin NiFe-Layered Double Hydroxide Nanosheets: An Efficient Overall Water Splitting Electrocatalyst. *Advanced Energy Materials*, *6*(10).

Jiang, J., Liu, Q., Zeng, C. and Ai, L., 2017. Cobalt/molybdenum carbide@ N-doped carbon as a bifunctional electrocatalyst for hydrogen and oxygen evolution reactions. *Journal of materials chemistry A*, *5*(32), pp.16929-16935.

Jiao, Y., Zheng, Y., Jaroniec, M. and Qiao, S.Z., 2015. Design of electrocatalysts for oxygen-and hydrogen-involving energy conversion reactions. *Chemical Society Reviews*, *44*(8), pp.2060-2086.

Jin, H., Wang, J., Su, D., Wei, Z., Pang, Z. and Wang, Y., 2015. In situ cobalt–cobalt oxide/N-doped carbon hybrids as superior bifunctional electrocatalysts for hydrogen and oxygen evolution. *Journal of the American Chemical Society*, *137*(7), pp.2688-2694.

Ju, H., Duan, J., Yang, Y., Cao, N. and Li, Y., 2018. Mapping the galvanic corrosion of three coupled metal alloys using coupled multielectrode array: influence of chloride ion concentration. *Materials*, *11*(4), p.634.

Kashyap, B. and Kumar, R., 2022. A novel multi-set differential pulse voltammetry technique for improving precision in electrochemical sensing. *Biosensors and Bioelectronics*, *216*, p.114628.

Khan, S.A., Khan, S.B. and Asiri, A.M., 2015. Core–shell cobalt oxide mesoporous silica based efficient electro-catalyst for oxygen evolution. *New Journal of Chemistry*, *39*(7), pp.5561-5569.

Kim, B.K., Kim, S.K., Cho, S.K. and Kim, J.J., 2018. Enhanced catalytic activity of electrodeposited Ni-Cu-P toward oxygen evolution reaction. *Applied Catalysis B: Environmental*, *237*, pp.409-415.

Klingele, M., Pham, C., Vuyyuru, K.R., Britton, B., Holdcroft, S., Fischer, A. and Thiele, S., 2017. Sulfur doped reduced graphene oxide as metal-free catalyst for the oxygen reduction reaction in anion and proton exchange fuel cells. *Electrochemistry Communications*, *77*, pp.71-75.

Kosmala, T., Calvillo, L., Agnoli, S. and Granozzi, G., 2018. Enhancing the Oxygen Electroreduction Activity through Electron Tunnelling: CoO x Ultrathin Films on Pd (100). *ACS catalysis*, *8*(3), pp.2343-2352.

Krishna, D.N.G. and Philip, J., 2022. Review on surface-characterization applications of X-ray photoelectron spectroscopy (XPS): Recent developments and challenges. *Applied Surface Science Advances*, *12*, p.100332.

Kumar, S., Mondal, R., Prakash, R. and Singh, P., 2022. Eldfellite-structured NaCr (SO 4) 2: a potential anode for rechargeable Na-ion and Li-ion batteries. *Dalton Transactions*, *51*(31), pp.11823-11833.

Kumar, S., Ranjeeth, R., Mishra, N.K., Prakash, R. and Singh, P., 2022. NASICON-structured Na 3 Fe 2 PO 4 (SO 4) 2: a potential cathode material for rechargeable sodium-ion batteries. *Dalton Transactions*, *51*(15), pp.5834-5840.

Lee, S.J.N.N., 2010. N. yabuuchi, BM Gallant, S. Chen, B.-S. Kim, PT Hammond, and Y. Shao-Horn. *Nat. Nnanotechnol*, *5*, p.531.

Li, C.C. and Zeng, H.C., 2010. Cobalt (hcp) nanofibers with pine-tree-leaf hierarchical superstructures. *Journal of Materials Chemistry*, *20*(41), pp.9187-9192.

Li, D.J., Li, Q.H., Gu, Z.G. and Zhang, J., 2019. A surface-mounted MOF thin film with oriented nanosheet arrays for enhancing the oxygen evolution reaction. *Journal of materials chemistry A*, *7*(31), pp.18519-18528.

Li, H., Wen, P., Li, Q., Dun, C., Xing, J., Lu, C., Adhikari, S., Jiang, L., Carroll, D.L. and Geyer, S.M., 2023. Earth-Abundant Iron Diboride (FeB2) Nanoparticles as Highly Active Bifunctional Electrocatalysts for Overall Water Splitting.

Li, H.C., Zhang, Y.J., Hu, X., Liu, W.J., Chen, J.J. and Yu, H.Q., 2018. Metal–organic framework templated Pd@ PdO–Co3O4 nanocubes as an efficient bifunctional oxygen electrocatalyst. *Advanced Energy Materials*, *8*(11), p.1702734.

Li, J., 2022. Oxygen evolution reaction in energy conversion and storage: design strategies under and beyond the energy scaling relationship. *Nano-Micro Letters*, *14*(1), p.112.

Li, L., Chang, Z.W. and Zhang, X.B., 2017. Recent progress on the development of metal-air batteries. *advanced sustainable systems*, *1*(10), p.1700036.

Li, X., Hao, X., Abudula, A. and Guan, G., 2016. Nanostructured catalysts for electrochemical water splitting: current state and prospects. *Journal of Materials Chemistry A*, *4*(31), pp.11973-12000.

Li, X., Zhao, L., Yu, J., Liu, X., Zhang, X., Liu, H. and Zhou, W., 2020. Water splitting: from electrode to green energy system. *Nano-Micro Letters*, *12*, pp.1-29.

Li, Y. and Zhao, C., 2017. Enhancing water oxidation catalysis on a synergistic phosphorylated NiFe hydroxide by adjusting catalyst wettability. *Acs Catalysis*, *7*(4), pp.2535-2541.

Li, Y., Hu, X., Ding, D., Zou, Y., Xu, Y., Wang, X., Zhang, Y., Chen, L., Chen, Z. and Tan, W., 2017. In situ targeted MRI detection of Helicobacter pylori with stable magnetic graphitic nanocapsules. *Nature communications*, *8*(1), p.15653.

Li, Y., Liu, J., Chen, C., Zhang, X. and Chen, J., 2017. Preparation of NiCoP hollow quasi-polyhedra and their electrocatalytic properties for hydrogen evolution in alkaline solution. *ACS applied materials & interfaces*, *9*(7), pp.5982-5991.

Liang, Q., Brocks, G. and Bieberle-Hütter, A., 2021. Oxygen evolution reaction (OER) mechanism under alkaline and acidic conditions. *Journal of Physics: Energy*, *3*(2), p.026001.

Liang, Y., Li, Y., Wang, H. and Dai, H., 2013. Strongly coupled inorganic/nanocarbon hybrid materials for advanced electrocatalysis. *Journal of the American Chemical Society*, *135*(6), pp.2013-2036.

Ling, T., Yan, D.Y., Wang, H., Jiao, Y., Hu, Z., Zheng, Y., Zheng, L., Mao, J., Liu, H., Du, X.W. and Jaroniec, M., 2017. Activating cobalt (II) oxide nanorods for efficient electrocatalysis by strain engineering. *Nature communications*, *8*(1), p.1509.

Lisdat, F. and Schäfer, D., 2008. The use of electrochemical impedance spectroscopy for biosensing. *Analytical and bioanalytical chemistry*, *391*, pp.1555-1567.

Liu, Y., Cheng, H., Lyu, M., Fan, S., Liu, Q., Zhang, W., Zhi, Y., Wang, C., Xiao, C., Wei, S. and Ye, B., 2014. Low overpotential in vacancy-rich ultrathin CoSe2 nanosheets for water oxidation. *Journal of the American Chemical society*, *136*(44), pp.15670-15675.

Liu, Y., Zhang, M., Hu, D., Li, R., Hu, K. and Yan, K., 2019. Ar plasma-exfoliated ultrathin NiCo-layered double hydroxide nanosheets for enhanced oxygen evolution. *ACS Applied Energy Materials*, *2*(2), pp.1162-1168.

Liu, Z., Li, N., Zhao, H., Zhang, Y., Huang, Y., Yin, Z. and Du, Y., 2017. Regulating the active species of Ni (OH) 2 using CeO 2: 3D CeO 2/Ni (OH) 2/carbon foam as an efficient electrode for the oxygen evolution reaction. *Chemical science*, *8*(4), pp.3211-3217.

Lu, W., Liu, T., Xie, L., Tang, C., Liu, D., Hao, S., Qu, F., Du, G., Ma, Y., Asiri, A.M. and Sun, X., 2017. In Situ Derived Co□ B Nanoarray: A High-Efficiency and Durable 3D Bifunctional Electrocatalyst for Overall Alkaline Water Splitting. *Small*, *13*(32), p.1700805.

Lu, Y.C., Gasteiger, H.A., Parent, M.C., Chiloyan, V. and Shao-Horn, Y., 2010. The influence of catalysts on discharge and charge voltages of rechargeable Li–oxygen batteries. *Electrochemical and Solid-State Letters*, *13*(6), p.A69.

Luo, J., Im, J.H., Mayer, M.T., Schreier, M., Nazeeruddin, M.K., Park, N.G., Tilley, S.D., Fan, H.J. and Grätzel, M., 2014. Water photolysis at 12.3% efficiency via perovskite photovoltaics and Earth-abundant catalysts. *Science*, *345*(6204), pp.1593-1596.

Mamtani, K., Jain, D., Dogu, D., Gustin, V., Gunduz, S., Co, A.C. and Ozkan, U.S., 2018. Insights into oxygen reduction reaction (ORR) and oxygen evolution reaction (OER) active sites for nitrogen-doped carbon nanostructures (CNx) in acidic media. *Applied Catalysis B: Environmental*, *220*, pp.88-97.

Man, I.C., Su, H.Y., Calle-Vallejo, F., Hansen, H.A., Martínez, J.I., Inoglu, N.G., Kitchin, J., Jaramillo, T.F., Nørskov, J.K. and Rossmeisl, J., 2011. Universality in oxygen evolution electrocatalysis on oxide surfaces. *ChemCatChem*, *3*(7), pp.1159-1165.

Matsumoto, K., Onoda, A., Campidell, S. and Hayashi, T., 2021. Electrocatalytic Hydrogen Evolution Reaction Promoted by Co/N/C Catalysts with Co–N x Active Sites Derived from Precursors Forming N-Doped Graphene Nanoribbons. *Bulletin of the Chemical Society of Japan*, *94*(12), pp.2898-2905.

McEvoy, J.P. and Brudvig, G.W., 2006. Water-splitting chemistry of photosystem II. *Chemical reviews*, *106*(11), pp.4455-4483.

Nishioka, S., Kobayashi, M., Lu, D., Kakihana, M. and Maeda, K., 2019. Selective synthesis and photocatalytic oxygen evolution activities of tantalum/nitrogen-codoped anatase, brookite and rutile titanium dioxide. *Bulletin of the Chemical Society of Japan*, *92*(6), pp.1032-1038.

Orazem, M.E. and Tribollet, B., 2008. Electrochemical impedance spectroscopy. *New Jersey*, *1*, pp.383-389.

Pan, Y., Xu, X., Zhong, Y., Ge, L., Chen, Y., Veder, J.P.M., Guan, D., O'Hayre, R., Li, M., Wang, G. and Wang, H., 2020. Direct evidence of boosted oxygen evolution over perovskite by enhanced lattice oxygen participation. *Nature communications*, *11*(1), p.2002.

Pandey, P.C. and Pandey, G., 2016. One-pot two-step rapid synthesis of 3-aminopropyltrimethoxysilane-mediated highly catalytic Ag@(PdAu) trimetallic nanoparticles. *Catalysis Science & Technology*, *6*(11), pp.3911-3917.

Pandey, P.C. and Shukla, S., 2018. Solvent dependent fabrication of bifunctional nanoparticles and nanostructured thin films by self assembly of organosilanes. *Journal of Sol-Gel Science and Technology*, *86*, pp.650-663.

Pandey, P.C. and Singh, R., 2015. Controlled synthesis of Pd and Pd–Au nanoparticles: effect of organic amine and silanol groups on morphology and polycrystallinity of nanomaterials. *RSC Advances*, *5*(15), pp.10964-10973.

Pandey, P.C., Mitra, M.D., Shukla, S. and Narayan, R.J., 2021. Organotrialkoxysilane-functionalized noble metal monometallic, bimetallic, and trimetallic nanoparticle mediated non-enzymatic sensing of glucose by resonance rayleigh scattering. *Biosensors*, *11*(4), p.122.

Pandey, P.C., Singh, R. and Pandey, A.K., 2014. Tetrahydrofuran hydroperoxide and 3-Aminopropyltrimethoxysilane mediated controlled synthesis of Pd, Pd-Au, Au-Pd nanoparticles: Role of Palladium nanoparticles on the redox electrochemistry of ferrocene monocarboxylic acid. *Electrochimica Acta*, *138*, pp.163-173.

Ping, Y., Nielsen, R.J. and Goddard III, W.A., 2017. The reaction mechanism with free energy barriers at constant potentials for the oxygen evolution reaction at the IrO2 (110) surface. *Journal of the American Chemical Society*, *139*(1), pp.149-155.

Qu, Q., Pan, G.L., Lin, Y.T. and Xu, C.W., Boosting the electrocatalytic performance of Pt, Pd and Au embedded within mesoporous cobalt oxide for oxygen evolution reaction. *International Journal of Hydrogen Energy*, 2018, *43*(31), pp.14252-14264.

Rajabalee, F.J.M., 1974. The chelates of divalent copper, nickel, zinc, lead, mercury, cobalt and manganese with nitrilotriacetic acid. *Journal of Inorganic and Nuclear Chemistry*, *36*(3), pp.557-564.

Rana, M., Mondal, S., Sahoo, L., Chatterjee, K., Karthik, P.E. and Gautam, U.K., 2018. Emerging materials in heterogeneous electrocatalysis involving oxygen for energy harvesting. *ACS applied materials & interfaces*, *10*(40), pp.33737-33767.

Rao, P., Liu, Y., Su, Y.Q., Zhong, M., Zhang, K., Luo, J., Li, J., Jia, C., Shen, Y., Shen, C. and Tian, X., 2021. S, N co-doped carbon nanotube encased Co NPs as efficient bifunctional oxygen electrocatalysts for zinc-air batteries. *Chemical Engineering Journal*, *422*, p.130135.

Reddy, T.B. and Linden, D., 2011. Linden's handbook of batteries.

Regmi, Y.N., Peng, X., Fornaciari, J.C., Wei, M., Myers, D.J., Weber, A.Z. and Danilovic, N., 2020. A low temperature unitized regenerative fuel cell realizing 60% round trip efficiency and 10000 cycles of durability for energy storage applications. *Energy & Environmental Science*, *13*(7), pp.2096-2105.

Rong, X., Parolin, J. and Kolpak, A.M., 2016. A fundamental relationship between reaction mechanism and stability in metal oxide catalysts for oxygen evolution. *Acs Catalysis*, *6*(2), pp.1153-1158.

Rossmeisl, J., Logadottir, A. and Nørskov, J.K., 2005. Electrolysis of water on (oxidized) metal surfaces. *Chemical physics*, *319*(1-3), pp.178-184.

Rossmeisl, J., Qu, Z.W., Zhu, H., Kroes, G.J. and Nørskov, J.K., 2007. Electrolysis of water on oxide surfaces. *Journal of Electroanalytical Chemistry*, *607*(1-2), pp.83-89.

Sayeed, M.A., Herd, T. and O'Mullane, A.P., 2016. Direct electrochemical formation of nanostructured amorphous Co (OH) 2 on gold electrodes with enhanced activity for the oxygen evolution reaction. *Journal of materials chemistry A*, *4*(3), pp.991-999.

Selvam, N.C.S., Du, L., Xia, B.Y., Yoo, P.J. and You, B., 2021. Reconstructed water oxidation electrocatalysts: the impact of surface dynamics on intrinsic activities. *Advanced Functional Materials*, *31*(12), p.2008190.

Singh, C., Singh, K. and Pandey, P.C., 2023. Synthesis and Properties of Organotrialkoxysilane Functionalized Palladium–Cobalt Heterogeneous Catalysts for Oxygen Evolution Reaction. *Russian Journal of Electrochemistry*, *59*(8), pp.604-615.

Snir, N., Yatom, N. and Toroker, M.C., 2019. Progress in understanding hematite electrochemistry through computational modeling. *Computational Materials Science*, *160*, pp.411-419.

Song, F., Bai, L., Moysiadou, A., Lee, S., Hu, C., Liardet, L. and Hu, X., 2018. Transition metal oxides as electrocatalysts for the oxygen evolution reaction in alkaline solutions: an application-inspired renaissance. *Journal of the American Chemical Society*, *140*(25), pp.7748-7759.

Song, M.Y., Yang, D.S., Singh, K.P., Yuan, J. and Yu, J.S., 2016. Nitrogen-doped hollow carbon spheres with highly graphitized mesoporous shell: Role of Fe for oxygen evolution reaction. *Applied Catalysis B: Environmental*, *191*, pp.202-208.

Stern, L.A. and Hu, X., 2014. Enhanced oxygen evolution activity by NiO x and Ni (OH) 2 nanoparticles. *Faraday discussions*, *176*, pp.363-379.

Stoerzinger, K.A., Qiao, L., Biegalski, M.D. and Shao-Horn, Y., 2014. Orientation-dependent oxygen evolution activities of rutile IrO2 and RuO2. *The journal of physical chemistry letters*, *5*(10), pp.1636-1641.

Sun, F., Li, C., Li, B. and Lin, Y., 2017. Amorphous MoS x developed on Co (OH) 2 nanosheets generating efficient oxygen evolution catalysts. *Journal of materials chemistry A*, *5*(44), pp.23103-23114.

Sun, F., Li, L., Wang, G. and Lin, Y., 2017. Iron incorporation affecting the structure and boosting catalytic activity of β-Co (OH) 2: Exploring the reaction mechanism of ultrathin two-dimensional carbon-free Fe 3 O 4-decorated β-Co (OH) 2 nanosheets as efficient oxygen evolution electrocatalysts. *Journal of materials chemistry A*, *5*(15), pp.6849-6859.

Sun, W., Wang, F., Zhang, B., Zhang, M., Küpers, V., Ji, X., Theile, C., Bieker, P., Xu, K., Wang, C. and Winter, M., 2021. A rechargeable zinc-air battery based on zinc peroxide chemistry. *Science*, *371*(6524), pp.46-51.

Tahir, M., Pan, L., Idrees, F., Zhang, X., Wang, L., Zou, J.J. and Wang, Z.L., 2017. Electrocatalytic oxygen evolution reaction for energy conversion and storage: A comprehensive review. *Nano Energy*, *37*, pp.136-157.

Tang, T., Jiang, W.J., Niu, S., Liu, N., Luo, H., Chen, Y.Y., Jin, S.F., Gao, F., Wan, L.J. and Hu, J.S., 2017. Electronic and morphological dual modulation of cobalt carbonate hydroxides by Mn doping toward highly efficient and stable bifunctional electrocatalysts for overall water splitting. *Journal of the American Chemical Society*, *139*(24), pp.8320-8328.

Tian, J., Liu, Q., Asiri, A.M. and Sun, X., 2014. Self-supported nanoporous cobalt phosphide nanowire arrays: an efficient 3D hydrogen-evolving cathode over the wide range of pH 0–14. *Journal of the American Chemical Society*, *136*(21), pp.7587-7590.

Trasatti, S. and Petrii, O.A., 1992. Real surface area measurements in electrochemistry. *Journal of Electroanalytical Chemistry*, *327*(1-2), pp.353-376.

Tsutsumi, M., Islam, M.S., Karim, M.R., Rabin, N.N., Ohtani, R., Nakamura, M., Lindoy, L.F. and Hayami, S., 2017. Tri-functional OER, HER and ORR electrocatalyst electrodes from in situ metal-nitrogen co-doped oxidized graphite rods. *Bulletin of the Chemical Society of Japan*, *90*(8), pp.950-954.

Viswanathan, V., Hansen, H.A. and Nørskov, J.K., 2015. Selective electrochemical generation of hydrogen peroxide from water oxidation. *The journal of physical chemistry letters*, *6*(21), pp.4224-4228.

Wang, B., Chen, K., Wang, G., Liu, X., Wang, H. and Bai, J., 2019. A multidimensional and hierarchical carbon-confined cobalt phosphide nanocomposite as an advanced anode for lithium and sodium storage. *Nanoscale*, *11*(3), pp.968-985.

Wang, J., Li, K., Zhong, H.X., Xu, D., Wang, Z.L., Jiang, Z., Wu, Z.J. and Zhang, X.B., 2015. Synergistic effect between metal–nitrogen–carbon sheets and NiO nanoparticles for enhanced electrochemical water-oxidation performance. *Angewandte Chemie*, *127*(36), pp.10676-10680.

Wang, X., Chen, S., Reggiano, G., Thota, S., Wang, Y., Kerns, P., Suib, S.L. and Zhao, J., 2019. Au–Cu–M (M= Pt, Pd, Ag) nanorods with enhanced catalytic efficiency by galvanic replacement reaction. *Chemical communications*, *55*(9), pp.1249-1252.

Wang, Y., An, C., Wang, Y., Huang, Y., Chen, C., Jiao, L. and Yuan, H., 2014. Core–shell Co@ C catalyzed MgH 2: enhanced dehydrogenation properties and its catalytic mechanism. *Journal of Materials Chemistry A*, *2*(38), pp.16285-16291.

Wei, C., Sun, S., Mandler, D., Wang, X., Qiao, S.Z. and Xu, Z.J., 2019. Approaches for measuring the surface areas of metal oxide electrocatalysts for determining their intrinsic electrocatalytic activity. *Chemical Society Reviews*, *48*(9), pp.2518-2534.

Wurster, B., Grumelli, D., Hötger, D., Gutzler, R. and Kern, K., 2016. Driving the oxygen evolution reaction by nonlinear cooperativity in bimetallic coordination catalysts. *Journal of the American Chemical Society*, *138*(11), pp.3623-3626.

Xiao, C., Li, Y., Lu, X. and Zhao, C., 2016. Bifunctional porous NiFe/NiCo2O4/Ni foam electrodes with triple hierarchy and double synergies for efficient whole cell water splitting. *Advanced Functional Materials*, *26*(20), pp.3515-3523.

Xie, Y. and Sherwood, P.M., 1990. X-ray photoelectron-spectroscopic studies of carbon fiber surfaces. 11. Differences in the surface chemistry and bulk structure of different carbon fibers based on poly (acrylonitrile) and pitch and comparison with various graphite samples. *Chemistry of Materials*, *2*(3), pp.293-299.

Yang, Y., Fei, H., Ruan, G. and Tour, J.M., 2015. Porous cobalt-based thin film as a bifunctional catalyst for hydrogen generation and oxygen generation. *Advanced Materials (Deerfield Beach, Fla.)*, *27*(20), pp.3175-3180.

Yao, K., Zhai, M. and Ni, Y., 2019. α-Ni (OH) 2· 0.75 H2O nanofilms on Ni foam from simple NiCl2 solution: Fast electrodeposition, formation mechanism and application as an efficient bifunctional electrocatalyst for overall water splitting in alkaline solution. *Electrochimica Acta*, *301*, pp.87-96.

You, B., Jiang, N., Sheng, M., Bhushan, M.W. and Sun, Y., 2016. Hierarchically porous urchin-like Ni2P superstructures supported on nickel foam as efficient bifunctional electrocatalysts for overall water splitting. *Acs Catalysis*, *6*(2), pp.714-721.

Yu, J., Li, Q., Xu, C.Y., Chen, N., Li, Y., Liu, H., Zhen, L., Dravid, V.P. and Wu, J., 2017. NiSe 2 pyramids deposited on N-doped graphene encapsulated Ni foam for high-performance water oxidation. *Journal of materials chemistry A*, *5*(8), pp.3981-3986.

Yu, X.Y. and Lou, X.W., 2018. Mixed metal sulfides for electrochemical energy storage and conversion. *Advanced Energy Materials*, *8*(3), p.1701592.

Zhang, B., Zheng, X., Voznyy, O., Comin, R., Bajdich, M., García-Melchor, M., Han, L., Xu, J., Liu, M., Zheng, L. and García de Arquer, F.P., 2016. Homogeneously dispersed multimetal oxygen-evolving catalysts. *Science*, *352*(6283), pp.333-337.

Zhang, H., Jin, M. and Xia, Y., 2012. Enhancing the catalytic and electrocatalytic properties of Pt-based catalysts by forming bimetallic nanocrystals with Pd. *Chemical Society Reviews*, *41*(24), pp.8035-8049.

Zhang, J., Zhou, Q., Tang, Y., Zhang, L. and Li, Y., 2019. Zinc–air batteries: are they ready for prime time?. *Chemical Science*, *10*(39), pp.8924-8929.

Zhang, K., Ma, M., Li, P., Wang, D.H. and Park, J.H., 2016. Water splitting progress in tandem devices: moving photolysis beyond electrolysis. *Advanced Energy Materials*, *6*(15), p.1600602.

Zhang, K., Wang, C., Bin, D., Wang, J., Yan, B., Shiraishi, Y. and Du, Y., 2016. Fabrication of Pd/P nanoparticle networks with high activity for methanol oxidation. *Catalysis Science & Technology*, *6*(16), pp.6441-6447.

Zhang, Y., Ouyang, B., Xu, J., Jia, G., Chen, S., Rawat, R.S. and Fan, H.J., 2016. Rapid synthesis of cobalt nitride nanowires: highly efficient and low-cost catalysts for oxygen evolution. *Angewandte Chemie*, *128*(30), pp.8812-8816.

Zheng, F., Yang, Y. and Chen, Q., 2014. High lithium anodic performance of highly nitrogen-doped porous carbon prepared from a metal-organic framework. *Nature communications*, *5*(1), pp.1-10.

Zhu, Y., Cao, T., Cao, C., Luo, J., Chen, W., Zheng, L., Dong, J., Zhang, J., Han, Y., Li, Z. and Chen, C., 2018. One-pot pyrolysis to N-doped graphene with high-density Pt single atomic sites as heterogeneous catalyst for alkene hydrosilylation. *Acs Catalysis*, *8*(11), pp.10004-10011.

Zou, H., He, B., Kuang, P., Yu, J. and Fan, K., 2018. Metal–organic framework-derived nickel–cobalt sulfide on ultrathin mxene nanosheets for electrocatalytic oxygen evolution. *ACS applied materials & interfaces*, *10*(26), pp.22311-22319.

Zou, X. and Zhang, Y., 2015. Noble metal-free hydrogen evolution catalysts for water splitting. *Chemical Society Reviews*, *44*(15), pp.5148-5180.

Zuo, Y., Liu, Y., Li, J., Du, R., Han, X., Zhang, T., Arbiol, J., Divins, N.J., Llorca, J., Guijarro, N. and Sivula, K., 2019. In situ electrochemical oxidation of Cu2S into CuO nanowires as a durable and efficient electrocatalyst for oxygen evolution reaction. *Chemistry of materials*, *31*(18), pp.7732-7743.

1. Chitra Singh, Kulveer Singh, and Prem C. Pandey. "Synthesis and Properties of Organotrialkoxysilane Functionalized Palladium–Cobalt Heterogeneous Catalysts for Oxygen Evolution Reaction." Russian Journal of Electrochemistry 59, no. 8 (2023): 604-615 (2023). https://doi.org/10.1134/S1023193523080074

2. Chitra Singh, and Prem C. Pandey. "Studies on porous nanostructured Palladium-Cobalt Silica as Heterogeneous Catalysts for Oxygen Evolution Reactions." Russian Journal of Electrochemistry (2024). (accepted)

3. Chitra Singh et al, A Process for Organotrialkoxysilane Functionalized Palladium Nanoparticles as Potent Catalysts for Oxygen Evolution Reaction, Indian Patent 202111060340.

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