

References

- [1] B. Y. Roger, "The rate of electrolytic hydrogen and the heat of adsorption of hydrogen," *Transactions of the Faraday Society*, vol. 54, pp. 1053–1063, 1958.
- [2] M. A. Majid, "Renewable energy for sustainable development in India: current status, future prospects, challenges, employment, and investment opportunities," *Energy, Sustainability and Society*, vol. 10, pp. 1-36, 2020.
- [3] T. Huld and A. Gracia Amillo, "Estimating PV Module Performance over Large Geographical Regions: The Role of Irradiance, Air Temperature, Wind Speed and Solar Spectrum," *Energies*, vol. 8, pp. 5159–5181, 2015.
- [4] S. G. Pawar, N. V Pradnyakar, and J. P. Modak, "Piezoelectric transducer as a renewable energy source: A review," *Journal of Physics: Conference Series*, vol. 1913, p. 12042, 2021.
- [5] M. Yu, K. Wang, and H. Vredenburg, "Insights into low-carbon hydrogen production methods: Green, blue and aqua hydrogen," *International Journal of Hydrogen Energy*, vol. 46, pp. 21261–21273, 2021.
- [6] R. W. Howarth and M. Z. Jacobson, "How green is blue hydrogen?," *Energy Science & Engineering*, vol. 9, pp. 1676–1687, 2021.
- [7] J. Kim, H. Kim, and S. H. Ahn, "Electrodeposited Rhodium Phosphide with High Activity for Hydrogen Evolution Reaction in Acidic Medium," *ACS Sustainable Chemistry & Engineering*, vol. 7, pp. 14041–14050, 2019.
- [8] H. Yan, C. Tian, L. Wu, M. Meng, L. Zhao, and H. Fu, "Phosphorus-Modified Tungsten Nitride/Reduced Graphene Oxide as a High-Performance, Non-Noble-Metal Electrocatalyst for the Hydrogen Evolution Reaction," *Angewandte Chemie International Edition*, vol. 54, pp. 6325–6329, 2015.
- [9] V. Manisha, P. Tonya, and J. Li, "Supercapacitors: Review of Materials and Fabrication Methods," *Journal of Energy Engineering*, vol. 139, pp. 72–79, 2013.
- [10] A. S. Arico, P. Bruce, B. Scrosati, J. M. Tarascon, and W. Van Schalkwijk, "Nanostructured materials for advanced energy conversion and storage devices," in

Materials for Sustainable Energy: a collection of peer-reviewed research and review articles from Nature Publishing Group, pp. 148–159, 2011.

[11] Jaidev, R. I. Jafri, A. K. Mishra, and S. Ramaprabhu, “Polyaniline-MnO₂ nanotube hybrid nanocomposite as supercapacitor electrode material in acidic electrolyte,” *Journal of Materials Chemistry*, vol. 21, pp. 17601–17605, 2011.

[12] K. Liu and M. A. Anderson, “Porous nickel oxide/nickel films for electrochemical capacitors,” *Journal of The Electrochemical Society*, vol. 143, pp. 124–130, 1996.

[13] J. Ortiz Balbuena, P. Tutor De Ureta, E. Rivera Ruiz, and S. Mellor Pita, “Enfermedad de Vogt-Koyanagi-Harada,” *Medicina Clinica*, vol. 146, pp. 93–94, 2016.

[14] R.R. Nair, P. Blake, A.N. Grigorenko, K.S. Novoselov, T.J. Booth, T. Stauber, N.M. Peres and A.K. Geim, “Fine Structure Constant Defines Visual Transparency of Graphene,” *Science*, vol. 320, pp. 1308-1308, 2008.

[15] W. Choi, N. Choudhary, G. H. Han, J. Park, D. Akinwande, and Y. H. Lee, “Recent development of two-dimensional transition metal dichalcogenides and their applications,” *Materials Today*, vol. 20, pp. 116–130, 2017.

[16] Q. Li, M. Horn, Y. Wang, J. MacLeod, N. Motta, and J. Liu, “A Review of Supercapacitors Based on Graphene and Redox-Active Organic Materials,” *Materials*, vol. 12, pp. 703-703, 2019.

[17] M. Chhowalla, H. S. Shin, G. Eda, L.-J. Li, K. P. Loh, and H. Zhang, “The chemistry of two-dimensional layered transition metal dichalcogenide nanosheets,” *Nature chemistry*, vol. 5, pp. 263–275, 2013.

[18] A. A. Balandin, “Thermal properties of graphene and nanostructured carbon materials,” *Nature Materials*, vol. 10, pp. 569–581, 2011.

[19] S. De and J. N. Coleman, “Are There Fundamental Limitations on the Sheet Resistance and Transmittance of Thin Graphene Films?,” *ACS Nano*, vol. 4, pp. 2713–2720, 2010.

[20] A. K. Geim and K. S. Novoselov, “The rise of graphene,” *Nanoscience and Technology*, pp. 11–19, 2009.

- [21] S. Park and R. S. Ruoff, "Chemical methods for the production of graphenes," *Nature Nanotechnology*, vol. 4, pp. 217–224, 2009.
- [22] X. Li, W. J. An and S. Kim, "Large-Area Synthesis of High-Quality and Uniform Graphene Films on Copper Foils," *Science*, vol. 324, pp. 1312–1314, 2009.
- [23] C. Berger, Z. Song, X. Li, X. Wu, N. Brown, C. Naud, D. Mayou, T. Li, J. Hass, A. N. Marchenkov, E. H. Conrad, P. N. First and W. A. de Heer, "Electronic Confinement and Coherence in Patterned Epitaxial Graphene," *Science*, vol. 312, pp. 1191–1196, 2006.
- [24] M. S. A. Bhuyan, M. N. Uddin, M. M. Islam, F. A. Bipasha, and S. S. Hossain, "Synthesis of graphene," *International Nano Letters*, vol. 6, pp. 65–83, 2016.
- [25] V. C. Tung, M. J. Allen, Y. Yang, and R. B. Kaner, "High-throughput solution processing of large-scale graphene," *Nature Nanotechnology*, vol. 4, pp. 25–29, 2009.
- [26] N. Liu, F. Luo, H. Wu, Y. Liu, C. Zhang, and J. Chen, "One-Step Ionic-Liquid-Assisted Electrochemical Synthesis of Ionic-Liquid-Functionalized Graphene Sheets Directly from Graphite," *Advanced Functional Materials*, vol. 18, pp. 1518–1525, 2008.
- [27] L. Dössel, L. Gherghel, X. Feng, and K. Müllen, "Graphene nanoribbons by chemists: Nanometer-sized, soluble, and defect-free," *Angewandte Chemie - International Edition*, vol. 50, pp. 2540–2543, 2011.
- [28] T. M. Bernhardt, B. Kaiser, and K. Rademann, "Formation of superperiodic patterns on highly oriented pyrolytic graphite by manipulation of nanosized graphite sheets with the STM tip," *Surface Science*, vol. 408, pp. 86–94, 1998.
- [29] T. W. Ebbesen and H. Hiura, "Graphene in 3-dimensions: Towards graphite origami," *Advanced Materials*, vol. 7, pp. 582–586, 1995.
- [30] W. S. Hummers and R. E. Offeman, "Preparation of Graphitic Oxide," *Journal of the American Chemical Society*, vol. 80, p. 1339, 1958.
- [31] C. K. Chua and M. Pumera, "Chemical reduction of graphene oxide: A synthetic chemistry viewpoint," *Chemical Society Reviews*, vol. 43, pp. 291–312, 2014.
- [32] J. Wu, W. Pisula, and K. Müllen, "Graphenes as Potential Material for Electronics," *Chemical Reviews*, vol. 107, pp. 718–747, 2007.

- [33] L. Zhi and K. Müllen, “A bottom-up approach from molecular nanographenes to unconventional carbon materials,” *Journal of Materials Chemistry*, vol. 18, pp. 1472–1484, 2008.
- [34] D. Voiry, J. Yang, J. Kupferberg, R. Fullon, C. Lee, H. Y. Jeong, H. S. Shin, M. Chhowalla, “High-quality graphene via microwave reduction of solution-exfoliated graphene oxide,” *Science*, vol. 353, pp. 1413–1416, 2016.
- [35] G. Jo, M. Choe, S. Lee, W. Park, Y. K.- Nanotechnology, and undefined 2012, “The application of graphene as electrodes in electrical and optical devices,” *iopscience.iop.org*, vol. 23, pp. 112001, 2012.
- [36] H. Im and J. Kim, “Thermal conductivity of a graphene oxide-carbon nanotube hybrid/epoxy composite,” *Carbon*, vol. 50, pp. 5429–5440, 2012.
- [37] S. Stankovich, D. A. Dikin, R. D. Piner, K. A. Kohlhaas, A. Kleinhammes, Y. Jia, Y. Wu, S. T. Nguyen, R. S. Ruoff, “Synthesis of graphene-based nanosheets via chemical reduction of exfoliated graphite oxide,” *Carbon*, vol. 45, pp. 1558–1565, 2007.
- [38] Y. Zeng, T. Li, Y. Yao, T. Li, L. Hu, and A. Marconnet, “Thermally Conductive Reduced Graphene Oxide Thin Films for Extreme Temperature Sensors,” *Advanced Functional Materials*, vol. 29, pp. 1–7, 2019.
- [39] C. Gómez-Navarro, M. Burghard, and K. Kern, “Elastic Properties of Chemically Derived Single Graphene Sheets,” *Nano Letters*, vol. 8, pp. 2045–2049, 2008.
- [40] S. K. Pal, “Versatile photoluminescence from graphene and its derivatives,” *Carbon*, vol. 88, pp. 86–112, 2015.
- [41] T. F. Yeh, C. Y. Teng, L. C. Chen, S. J. Chen, and H. Teng, “Graphene oxide-based nanomaterials for efficient photoenergy conversion,” *Journal of Materials Chemistry A*, vol. 4, pp. 2014–2048, 2016.
- [42] Z. Yin, S. Sun, T. Salim, S. Wu, X. Huang, Q. He, Y. M. Lam and H. Zhang, “Organic photovoltaic devices using highly flexible reduced graphene oxide films as transparent electrodes,” *ACS Nano*, vol. 4, pp. 5263–5268, 2010.
- [43] X. Li and H. Zhu, “Two-dimensional MoS₂: Properties, preparation, and applications,” *Journal of Materiomics*, vol. 1, pp. 33–44, 2015.

- [44] Z. Wei, B. Li, C. Xia, Y. Cui, J. He, J. Xia and J. Li, “Various Structures of 2D Transition-Metal Dichalcogenides and Their Applications,” *Small Methods*, vol. 2, pp. 1800094, 2018.
- [45] Y. Li, K. Chang, Z. Sun, E. Shangguan, H. Tang, Bao Li, J. Sun, and Z. Chang, “Selective Preparation of 1T- and 2H-Phase MoS₂ Nanosheets with Abundant Monolayer Structure and Their Applications in Energy Storage Devices,” *ACS Applied Energy Materials*, vol. 3, pp. 998–1009, 2020.
- [46] R. Lv, J. A. Robinson, R. E. Schaak, D. Sun, Y. Sun, T. E. Mallouk, and M. Terrones, “Transition Metal Dichalcogenides and Beyond: Synthesis, Properties, and Applications of Single- and Few-Layer Nanosheets,” *Accounts of Chemical Research*, vol. 48, pp. 56–64, 2015.
- [47] Q. H. Wang, K. Kalantar-Zadeh, A. Kis, J. N. Coleman, and M. S. Strano, “Electronics and optoelectronics of two-dimensional transition metal dichalcogenides,” *Nature Nanotechnology*, vol. 7, pp. 699–712, 2012.
- [48] R. J. Smith, P. J. King, M. Lotya, C. Wirtz, U. Khan, S. De, A. O’Neill, G. S. Duesberg, J. C. Grunlan, G. Moriarty, J. Chen, J. Wang, A. I. Minett, V. Nicolosi, and J. N. Coleman, “Large-scale exfoliation of inorganic layered compounds in aqueous surfactant solutions,” *Advanced Materials*, vol. 23, pp. 3944–3948, 2011.
- [49] A. K. Mishra, K. V. Lakshmi, and L. Huang, “Eco-friendly synthesis of metal dichalcogenides nanosheets and their environmental remediation potential driven by visible light,” *Scientific Reports*, vol. 5, pp. 15718–15718, 2015.
- [50] F. Wang, T. A. Shifa, X. Zhan, Y. Huang, K. Liu, Z. Cheng, C. Jiang and J. He, “Recent advances in transition-metal dichalcogenide based nanomaterials for water splitting,” *Nanoscale*, vol. 7, pp. 19764–19788, 2015.
- [51] Y. H. Lee, X. Q. Zhang, W. Zhang, M. T. Chang, C. T. Lin, K. D. Chang, Y. C. Yu, J. T. W. Wang, C. S. Chang, L. J. Li and T. W. Lin, “Synthesis of Large-Area MoS₂ Atomic Layers with Chemical Vapor Deposition,” *Advanced Materials*, vol. 24, pp. 2320–2325, 2012.

- [52] P. Johari and V. B. Shenoy, "Tuning the Electronic Properties of Semiconducting Transition Metal Dichalcogenides by Applying Mechanical Strains," *ACS Nano*, vol. 6, no. 6, pp. 5449–5456, 2012.
- [53] K. Karuppasamy, J. Theerthagiri, D. Vikraman, C. J. Yim, S. Hussain, R. Sharma, T. Maiyalagan, J. Qin, H. S. Kim "Ionic liquid-based electrolytes for energy storage devices: A brief review on their limits and applications", *Polymers*, vol 6, pp. 918-825.
- [54] M. B. Askari, A. F. Kalourazi, M. Seifi, S. S. Shahangian, N. Askari, and T. J. Manjili, "Hydrothermal Synthesis of molybdenum disulfide (MoS₂) and study of structure, optical, electrical and high Antibacterial properties," *Optik*, vol. 174, pp. 154–162, 2018.
- [55] Y. Ge, R. Jalili, C. Wang, T. Zheng, Y. Chao, and G. G. Wallace, "A robust free-standing MoS₂/poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) film for supercapacitor applications," *Electrochimica Acta*, vol. 235, pp. 348–355, 2017.
- [56] M. Bernardi, M. Palummo, and J. C. Grossman, "Extraordinary Sunlight Absorption and One Nanometer Thick Photovoltaics Using Two-Dimensional Monolayer Materials," *Nano Letters*, vol. 13, no. 8, pp. 3664–3670, 2013.
- [57] M. Hashemi, N. Ansari, and M. Vazayefi, "MoS₂-based absorbers with whole visible spectrum coverage and high efficiency," *Scientific reports*, vol. 12, pp. 6313, 2022.
- [58] N. Chaudhary, M. Khanuja, Abid, and S. S. Islam, "Hydrothermal synthesis of MoS₂ nanosheets for multiple wavelength optical sensing applications," *Sensors and Actuators, A: Physical*, vol. 277, pp. 190–198, 2018.
- [59] B. D. Solomon and K. Krishna, "The coming sustainable energy transition: History, strategies, and outlook," *Energy Policy*, vol. 39, pp. 7422–7431, 2011.
- [60] N. L. Panwar, S. C. Kaushik, and S. Kothari, "Role of renewable energy sources in environmental protection: A review," *Renewable and Sustainable Energy Reviews*, vol. 15, no. 3, pp. 1513–1524, 2011.
- [61] C. Binz, J. Gosens, T. Hansen, and U. E. Hansen, "Toward Technology-Sensitive Catching-Up Policies: Insights from Renewable Energy in China," *World Development*, vol. 96, pp. 418–437, 2017.

- [62] Q. Cheng and H. Yi, “Complementarity and substitutability: A review of state level renewable energy policy instrument interactions,” *Renewable and Sustainable Energy Reviews*, vol. 67, pp. 683–691, 2017.
- [63] J. Chen, J. Xu, S. Zhou, N. Zhao, and C.-P. Wong, “Amorphous nanostructured FeOOH and Co–Ni double hydroxides for high-performance aqueous asymmetric supercapacitors,” *Nano Energy*, vol. 21, pp. 145–153, 2016.
- [64] N. M. Marković, B. N. Grgur, and P. N. Ross, “Temperature-Dependent Hydrogen Electrochemistry on Platinum Low-Index Single-Crystal Surfaces in Acid Solutions,” *The Journal of Physical Chemistry B*, vol. 101, pp. 5405–5413, 1997.
- [65] B. E. Conway and M. Salomon, “Electrochemical reaction orders: Applications to the hydrogen- and oxygen-evolution reactions,” *Electrochimica Acta*, vol. 9, pp. 1599–1615, 1964.
- [66] X. Zou and Y. Zhang, “Noble metal-free hydrogen evolution catalysts for water splitting,” *Chemical Society Reviews*, vol. 44, pp. 5148–5180, 2015.
- [67] Y. Shi and B. Zhang, “Recent advances in transition metal phosphide nanomaterials: Synthesis and applications in hydrogen evolution reaction,” *Chemical Society Reviews*, vol. 45, pp. 1529–1541, 2016.
- [68] J. D. Benck, T. R. Hellstern, J. Kibsgaard, P. Chakthranont, and T. F. Jaramillo, “Catalyzing the Hydrogen Evolution Reaction (HER) with Molybdenum Sulfide Nanomaterials,” *ACS Catalysis*, vol. 4, pp. 3957–3971, 2014.
- [69] T. Li, D. Tang, Z. Cui, B. Cai, D. Li, Q. Chen, and C. Li, “Functionalized Carbon Nanotubes for Highly Active and Metal-Free Electrocatalysts in Hydrogen Evolution Reaction,” *Electrocatalysis*, vol. 9, pp. 573–581, 2018.
- [70] T. Li, Z. Cui, W. Yuan, and C. M. Li, “Ionic liquid functionalized carbon nanotubes: Metal-free electrocatalyst for hydrogen evolution reaction,” *RSC Advances*, vol. 6, no. 16, pp. 12792–12796, 2016.
- [71] D. Mosconi, P. Till, L. Calvillo, T. Kosmala, D. Garoli, D. Debellis, A. Martucci, S. Agnoli, and G. Granozzi, “Effect of Ni Doping on the MoS₂ Structure and Its Hydrogen Evolution Activity in Acid and Alkaline Electrolytes,” *Surfaces*, vol. 2, pp. 531–545, 2019.

- [72] B. T. Jebaslinhepzybai, T. Partheeban, D. S. Gavali, R. Thapa, and M. Sasidharan, "One-pot solvothermal synthesis of Co₂P nanoparticles: An efficient HER and OER electrocatalysts," *International Journal of Hydrogen Energy*, vol. 46, pp. 21924–21938, 2021.
- [73] B. Ren, D. Li, Q. Jin, H. Cui, C. Wang, "A self-supported porous WN nanowire array: An efficient 3D electrocatalyst for the hydrogen evolution reaction," *Journal of Materials Chemistry A*, vol. 5, pp. 19072–19078, 2017.
- [74] M. Fan, H. Chen, Y. Wu, L. L. Feng, Y. Lipu, X. Zou, "Growth of molybdenum carbide micro-islands on carbon cloth toward binder-free cathodes for efficient hydrogen evolution reaction," *Journal of Materials Chemistry A*, vol. 3, pp. 16320–16326, 2015.
- [75] D. Liu, Q. Lu, Y. Luo, X. Sun, A. M. Asiri, "NiCo₂S₄ nanowires array as an efficient bifunctional electrocatalyst for full water splitting with superior activity," *Nanoscale*, vol. 7, pp. 15122–15126, 2015.
- [76] M. L. Zou, J. D. Chen, L. F. Xiao, H. Zhu, T. T. Yang, M. Zhanga and M. L. Du, "WSe₂ and W(Se_xS_{1-x})₂ nanoflakes grown on carbon nanofibers for the electrocatalytic hydrogen evolution reaction," *Journal of Materials Chemistry A*, vol. 3, pp. 18090–18097, 2015.
- [77] Z. Wu, B. Fang, Z. Wang, C. Wang, Z. Liu, F. Liu, W. Wang, A. Alfantazi, D. Wang, D. P. Wilkinson, "MoS₂ Nanosheets: A Designed Structure with High Active Site Density for the Hydrogen Evolution Reaction," *ACS Catalysis*, vol. 3, no. 9, pp. 2101–2107, 2013.
- [78] D. Wang, Z. Wang, C. Wang, P. Zhou, Z. Wu, Z. Liu, "Distorted MoS₂ nanostructures: An efficient catalyst for the electrochemical hydrogen evolution reaction," *Electrochemistry Communications*, vol. 34, pp. 219–222, 2013.
- [79] D. Voiry, M. Salehi, R. Silva, T. Fujita, M. Chen, T. Asefa, V. B. Shenoy, G. Eda, M. Chhowalla., "Conducting MoS₂ nanosheets as catalysts for hydrogen evolution reaction," *Nano Letters*, vol. 13, pp. 6222–6227, 2013.
- [80] D. Kong, H. Wang, J. J. Cha, M. Pasta, K. J. Koski, J. Yao, Yi Cui, "Synthesis of MoS₂ and MoSe₂ Films with Vertically Aligned Layers," *Nano Letters*, vol. 13, pp. 1341–1347, Mar. 2013.

- [81] A. Ghosh, Y. H. Lee, “Carbon-Based Electrochemical Capacitors,” *ChemSusChem*, vol. 5, pp. 480–499, Mar. 2012.
- [82] L. Zhang, X. S. Zhao, “Carbon-based materials as supercapacitor electrodes,” *Chemical Society Reviews*, vol. 38, pp. 2520–2531, 2009.
- [83] P. Simon, Y. Gogotsi, “Materials for electrochemical capacitors,” in *Nanoscience and Technology*, Co-Published with Macmillan Publishers Ltd, UK, 2009, pp. 320–329.
- [84] A. G. Pandolfo, A. F. Hollenkamp, “Carbon properties and their role in supercapacitors,” *Journal of Power Sources*, vol. 157, 2006.
- [85] T. C. Mendes, F. Zhou, A. J. Barlow, M. Forsyth, P. C. Howlett, and D. R. MacFarlane, “An ionic liquid based sodium metal-hybrid supercapacitor-battery,” *Sustainable Energy and Fuels*, vol. 2, pp. 763–771, 2018.
- [86] A. Tyagi, R. K. Gupta, “Carbon Nanostructures from Biomass Waste for Supercapacitor Applications,” *Nanomaterials*, no. May 2016, pp. 261–282, 2018.
- [87] S. Zhang, N. Pan, “Supercapacitors performance evaluation,” *Advanced Energy Materials*, vol. 5, pp. 1–19, 2015.
- [88] T. Brousse, D. Bélanger, and J. W. Long, “To Be or Not To Be Pseudocapacitive?,” *Journal of The Electrochemical Society*, vol. 162, pp. 5185–5189, 2015.
- [89] L. Guan, L. Yu, G. Z. Chen, “Capacitive and non-capacitive faradaic charge storage,” *Electrochimica Acta*, vol. 206, pp. 464–478, 2016.
- [90] S. W. Bokhari, A. H. Siddique, P. C. Sherrell, X. Y. Kariappa, M. Karumbaihd, S. Wei, A. V. Ellis, W. Gao, “Advances in graphene-based supercapacitor electrodes,” *Energy Reports*, vol. 6, pp. 2768–2784, 2020.
- [91] P. E. Lokhande, U. S. Chavan, A. Pandey, “*Materials and Fabrication Methods for Electrochemical Supercapacitors: Overview*”, Springer Singapore, vol. 3, 2020.
- [92] Y. Wang, L. Zhang, H. Hou, W. Xu, G. Duan, S. He, K. Liu, S. Jianget, “Recent progress in carbon-based materials for supercapacitor electrodes: a review,” *Journal of Materials Science*, vol. 56, pp. 173–200, 2021.

- [93] Y. Wang, Y. Song, Y. Xia, “Electrochemical capacitors: Mechanism, materials, systems, characterization and applications,” *Chemical Society Reviews*, vol. 45, pp. 5925–5950, 2016.
- [94] M. Endo, T. Takeda, Y. J. Kim, K. Koshiba, K. Ishii, “High Power Electric Double Layer Capacitor (EDLC's); from Operating Principle to Pore Size Control in Advanced Activated Carbons,” *Carbon Science*, vol. 1, pp. 117–128, 2001.
- [95] M. Endo, T. Takeda, Y. J. Kim, K. Koshiba, K. Ishii, “High Power Electric Double Layer Capacitor (EDLC's); from Operating Principle to Pore Size Control in Advanced Activated Carbons,” *Carbon Science*, vol. 1, pp. 117–128, 2001.
- [96] X. Chen, R. Paul, L. Dai, “Carbon-based supercapacitors for efficient energy storage,” *National Science Review*, vol. 4, pp. 453–489, 2017.
- [97] A. K. Mishra, S. Ramaprabhu, “Functionalized Graphene-Based Nanocomposites for Supercapacitor Application,” *The Journal of Physical Chemistry C*, vol. 115, pp. 14006–14013, Jul. 2011.
- [98] C. Costentin, J. M. Savéant, “Energy storage: Pseudocapacitance in prospect,” *Chemical Science*, vol. 10, pp. 5656–5666, 2019.
- [99] M. Horn, B. Gupta, J. MacLeod, J. Liu, and N. Motta, “Graphene-based supercapacitor electrodes: Addressing challenges in mechanisms and materials,” *Current Opinion in Green and Sustainable Chemistry*, vol. 17, pp. 42–48, 2019.
- [100] F. Paquin, J. Rivnay, A. Salleo, N. Stingelin, and C. Silva, “Multi-phase semicrystalline microstructures drive exciton dissociation in neat plastic semiconductors,” *J. Mater. Chem. C*, vol. 3, pp. 10715–10722, 2015.
- [101] M. Pumera, “Graphene-based nanomaterials for energy storage,” *Energy and Environmental Science*, vol. 4, pp. 668–674, 2011.
- [102] Y. Sun, Q. Wu, G. Shi, “Graphene based new energy materials,” *Energy and Environmental Science*, vol. 4, pp. 1113–1132, 2011.
- [103] B. Zhang, J. Liang, C. L. Xu, B. Q. Wei, D. B. Ruan, D. H. Wu, “Electric double-layer capacitors using carbon nanotube electrodes and organic electrolyte,” *Materials Letters*, vol. 51, pp. 539–542, 2001.

- [104] L. Xie, G. Sun, F. Su, X. Guo, Q. Kong, X. Li, X. Huang, Liu Wan, W. Song, K. Li, C. Lva, C. M. Chen, "Hierarchical porous carbon microtubes derived from willow catkins for supercapacitor applications," *Journal of Materials Chemistry A*, vol. 4, pp. 1637–1646, 2016.
- [105] W. Kim, M.Y. Kang, J. B. Joo, N. D. Kim, I. K. Song, P. K. Jung, R. Yoon, J. Yi, "Preparation of ordered mesoporous carbon nanopipes with controlled nitrogen species for application in electrical double-layer capacitors," *Journal of Power Sources*, vol. 195, pp. 2125–2129, 2010.
- [106] L. Chen, X. D. Zhang, H. W. Liang, M. Kong, Q. F. Guan, P. Chen, Z. Y. Wu, S. H. Yu, "Synthesis of Nitrogen-Doped Porous Carbon Nano fibers as an Efficient Electrode Material for Supercapacitors," vol. 6, pp. 7092–7102, 2012.
- [107] M. D. Stoller, S. Park, Y. Zhu, J. An, R. S. Ruoff, "Graphene-Based Ultracapacitors," *Nano Letters*, vol. 8, pp. 3498–3502, Oct. 2008.
- [108] B. Rajagopalan, J. S. Chung, "Reduced chemically modified graphene oxide for supercapacitor electrode," *Nanoscale Research Letters*, vol. 9, pp. 535, 2014.
- [109] V. Augustyn, P. Simon, B. Dunn, "Pseudocapacitive oxide materials for high-rate electrochemical energy storage," *Energy and Environmental Science*, vol. 7, pp. 1597–1614, 2014.
- [110] Y. Jiang, J. Liu, "Definitions of Pseudocapacitive Materials: A Brief Review," *Energy & Environmental Materials*, vol. 2, pp. 30–37, 2019.
- [111] A. J. Stevenson, D. G. Gromadskyi, D. Hu, J. Chae, L. Guan, L. Yu, G. Z. Chen, "Supercapatteries with Hybrids of Redox Active Polymers and Nanostructured Carbons," *Nanocarbons for Advanced Energy Storage*, vol. 1, pp. 179–210, 2015.
- [112] T. P. Gujar, W. Y. Kim, I. Puspitasari, K. D. Jung, O. S. Joo, "Electrochemically deposited nanograin ruthenium oxide as a pseudocapacitive electrode," *International Journal of Electrochemical Science*, vol. 2, pp. 666–673, 2007.
- [113] C. Li, J. Li, Z. Wang, S. Zhang, G. Wei, J. Zhang, H. Wang, C. An, "The synthesis of hollow MoS₂ nanospheres assembled by ultrathin nanosheets for an enhanced energy storage performance," *Inorganic Chemistry Frontiers*, vol. 4, pp. 309–314, 2017.

- [114] X. Zhou, B. Xu, Z. Lin, D. Shu, L. Ma, "Hydrothermal synthesis of flower-like MoS₂ nanospheres for electrochemical supercapacitors," *Journal of Nanoscience and Nanotechnology*, vol. 14, pp. 7250–7254, 2014.
- [115] J. M. Soon, K. P. Loh, "Electrochemical double-layer capacitance of MoS₂ nanowall films," *Electrochemical and Solid-State Letters*, vol. 10, pp. 250–254, 2007.
- [116] W. S. Hummers, R. E. Offeman, "Preparation of Graphitic Oxide," *Journal of the American Chemical Society*, vol. 80, pp. 1339, 1958.
- [117] K. J. Huang, L. Wang, Y. J. Liu, T. Gan, Y. M. Liu, L. L. Wang, Y. Fan, "Synthesis and electrochemical performances of Layered tungsten sulfide-graphene nanocomposite as a sensing platform for catechol, resorcinol and hydroquinone," *Electrochimica Acta*, vol. 107, pp. 379–387, 2013.
- [118] S. M. S. Kumar, K. Selvakumara, R. Thangamuthua, A. K. Selvi, S. Ravichandran, G. Sozhan, K. Rajasekar, N. Navascues, S. Irusta, "Hydrothermal assisted morphology designed MoS₂ material as alternative cathode catalyst for PEM electrolyser application," *International Journal of Hydrogen Energy*, vol. 41, pp. 13331–13340, 2016.
- [119] A. Jamnig, "*Couches minces métalliques sur substrats à faible interaction Dynamics nanométriques de croissance, contraintes résiduelles*" et manipulation de morphologie., no. 2084. 2020.
- [120] M. Vallikkodi, "Synthesis, Growth and Characterization of Piperazinium p-Aminobenzoate and Piperazinium p-Chlorobenzoate Nonlinear Optical Single Crystals," Research Gate, April, pp. 77, 2018.
- [121] A. Mboniyiryvuzze, B. Mwakikunga, S. M. Dhlamini, M. Maaza, "Fourier Transform Infrared Spectroscopy for Sepia Melanin," *Physics and Materials Chemistry*, vol. 3, pp. 25–29, 2015.
- [122] Y. Shao, M. F. El-Kady, J. Sun, Y. Li, Q. Zhang, M. Zhu, H. Wang, B. .Dunn, R. B. Kaner, "Design and Mechanisms of Asymmetric Supercapacitors," *Chemical Reviews*, vol. 118, pp. 9233–9280, Sep. 2018.

- [123] D. K. Kampouris, X. Ji, E. P. Randviir, C. E. Banks, “A new approach for the improved interpretation of capacitance measurements for materials utilised in energy storage,” *RSC Advances*, vol. 5, pp. 12782–12791, 2015.
- [124] M. Ďurovič, J. Hnát, K. Bouzek, “Electrocatalysts for the hydrogen evolution reaction in alkaline and neutral media. A comparative review,” *Journal of Power Sources*, vol. 493, pp. 229708, 2021.
- [125] M. Zeng, Y. Li, “Recent advances in heterogeneous electrocatalysts for the hydrogen evolution reaction,” *Journal of Materials Chemistry A*, vol. 3, no. 29, pp. 14942–14962, 2015.
- [126] G. W. Crabtree, M. S. Dresselhaus, M. V. Buchanan, “The hydrogen economy,” *Physics Today*, vol. 57, pp. 39–44, 2004.
- [127] T. B. Ferriday, P. H. Middleton, M. L. Kolhe, “Review of the hydrogen evolution reaction—a basic approach,” *Energies*, vol. 14, pp. 8535, 2021.
- [128] M. Gu, J. Choi, T. Lee, M. Park, I. S. Shin, J. Hong, H. W. Lee, B. S. Kim, “Diffusion controlled multilayer electrocatalysts: Via graphene oxide nanosheets of varying sizes,” *Nanoscale*, vol. 10, pp. 16159–16168, 2018.
- [129] J. Wang, W. Cui, Q. Liu, Z. Xing, A. M. Asiri, X. Sun, “Recent Progress in Cobalt-Based Heterogeneous Catalysts for Electrochemical Water Splitting,” *Advanced Materials*, vol. 28, pp. 215–230, 2016.
- [130] X. Zou, Y. Zhang, “Noble metal-free hydrogen evolution catalysts for water splitting,” *Chemical Society Reviews*, vol. 44, pp. 5148–5180, 2015.
- [131] W. F. Chen, J. T. Muckerman, E. Fujita, “Recent developments in transition metal carbides and nitrides as hydrogen evolution electrocatalysts,” *Chemical Communications*, vol. 49, pp. 8896–8909, 2013.
- [132] C. Wang, J. Huang, J. Chen, Z. Xi, and X. Deng, “Progress in electrocatalytic hydrogen evolution based on monolayer molybdenum disulfide,” *Frontiers in Chemistry*, vol. 7, no. MAR, pp. 1–9, 2019, doi: 10.3389/fchem.2019.00131.

- [133] J. Xie, S. Li, X. Zhang, J. Zhang, R. Wang, H. Zhang, B. Pan, Y. Xie, “Atomically-thin molybdenum nitride nanosheets with exposed active surface sites for efficient hydrogen evolution,” *Chemical Science*, vol. 5, pp. 4615–4620, 2014.
- [134] Z. Pu, S. Wei, Z. Chen, and S. Mu, “Flexible molybdenum phosphide nanosheet array electrodes for hydrogen evolution reaction in a wide pH range,” *Applied Catalysis B: Environmental*, vol. 196, pp. 193–198, 2016.
- [135] Y. Yin, J. Han, Y. Zhang, X. Zhang, P. Xu, Q. Yuan, L. Samad, X. Wang, Y. Wang, Z. Zhang, P. Zhang, X. Cao, B. Song, S. Jin, “Contributions of Phase, Sulfur Vacancies, and Edges to the Hydrogen Evolution Reaction Catalytic Activity of Porous Molybdenum Disulfide Nanosheets,” *Journal of the American Chemical Society*, vol. 138, pp. 7965–7972, 2016.
- [136] G. Li, D. Zhang, Q. Qiao, Y. Yu, D. Peterson, A. Zafar, R. Kumar, S. Curtarolo, F. Hunte, S. Shannon, Y. Zhu, W. Yang, L. Cao, “All The Catalytic Active Sites of MoS₂ for Hydrogen Evolution,” *Journal of the American Chemical Society*, vol. 138, no. 51, pp. 16632–16638, 2016.
- [137] J. D. Benck, Z. Chen, L. Y. Kuritzky, A. J. Forman, T. F. Jaramillo, “Amorphous molybdenum sulfide catalysts for electrochemical hydrogen production: Insights into the origin of their catalytic activity,” *ACS Catalysis*, vol. 2, pp. 1916–1923, 2012.
- [138] Y. Cao, “Roadmap and Direction toward High-Performance MoS₂ Hydrogen Evolution Catalysts,” *ACS Nano*, vol. 15, no. 7, pp. 11014–11039, 2021.
- [139] J. Xie, H. Zhang, S. Li, R. Wang, X. Sun, M. Zhou, J. Zhou, X. W. (David) Lou, Y. Xie, “Defect-rich MoS₂ ultrathin nanosheets with additional active edge sites for enhanced electrocatalytic hydrogen evolution,” *Advanced Materials*, vol. 25, pp. 5807–5813, 2013.
- [140] J. Xie, J. Zhang, S. Li, F. Grote, X. Zhang, H. Zhang, R. Wang, Y. Lei, B. Pan, Y. Xie “Controllable disorder engineering in oxygen-incorporated MoS₂ ultrathin nanosheets for efficient hydrogen evolution,” *Journal of the American Chemical Society*, vol. 135, pp. 17881–17888, 2013.
- [141] D. Kong, H. Wang, J. J. Cha, M. Pasta, K. J. Koski, J. Yao, Y. Cui., “Synthesis of MoS₂ and MoSe₂ films with vertically aligned layers,” *Nano Letters*, vol. 13, pp. 1341–1347, 2013.

- [142] J. Kibsgaard, Z. Chen, B. N. Reinecke, T. F. Jaramillo, "Engineering the surface structure of MoS₂ to preferentially expose active edge sites for electrocatalysis," *Nature Materials*, vol. 11, pp. 963–969, 2012.
- [143] H. Wang, C. Tsai, D. Kong, K. Chan, F. A. Pedersen, J. K. Nørskov, Y. Cui, "Transition-metal doped edge sites in vertically aligned MoS₂ catalysts for enhanced hydrogen evolution," *Nano Research*, vol. 8, pp. 566–575, 2015.
- [144] D. Wang, Z. Wang, C. Wang, P. Zhou, Z. Wu, Z. Liu, "Distorted MoS₂ nanostructures: An efficient catalyst for the electrochemical hydrogen evolution reaction," *Electrochemistry Communications*, vol. 34, pp. 219–222, 2013.
- [145] I. H. Gentle, K. Hellgardt, "A versatile open-source analysis of the limiting efficiency of photo electrochemical water-splitting," *Scientific Reports*, vol. 8, pp. 1–9, 2018.
- [146] R. Moca, "Novel Inorganic materials for hydrogen evolution reaction in electrochemical water splitting," PhD diss., University of Glasgow, 2019.
- [147] Y. Li, Q. Tan, H. Qin, and D. Xing, "Defect-rich single-layer MoS₂ nanosheets with high dielectric-loss for contrast-enhanced thermoacoustic imaging of breast tumor" *Applied Physics Letters*, vol. 115, pp.073701, 2019.
- [148] T. Shinagawa, K. Takanabe, "Towards Versatile and Sustainable Hydrogen Production through Electrocatalytic Water Splitting: Electrolyte Engineering," *ChemSusChem*, vol. 10, pp. 1318–1336, 2017.
- [149] N. Liu, Y. Guo, X Yang, H. Lin, L. Yang, Z. Shi, Z. Zhong, S. Wang, Y. Tang Q. Gao, "Microwave-Assisted Reactant-Protecting Strategy toward Efficient MoS₂ Electrocatalysts in Hydrogen Evolution Reaction," *ACS Applied Materials and Interfaces*, vol. 7, pp. 23741–23749, 2015.
- [150] S. J. R. Neale, D. A. C. Brownson, G. C. Smith, D. A. G. Sawtell, P. J. Kelly, C. E. Banks, "2D nanosheet molybdenum disulphide (MoS₂) modified electrodes explored towards the hydrogen evolution reaction," *Nanoscale*, vol. 7, pp. 18152–18168, 2015.
- [151] Y. Li, H. Wang, L. Xie, Y. Liang, G. Hong, H. Dai, "MoS₂ nanoparticles grown on graphene: An advanced catalyst for the hydrogen evolution reaction," *Journal of the American Chemical Society*, vol. 133, pp. 7296–7299, 2011.

- [152] L. Liao, J. Zhu, X. Bian, L. Zhu, M. D. Scanlon, H. H. Girault, B. Liu., “MoS₂ formed on mesoporous graphene as a highly active catalyst for hydrogen evolution,” *Advanced Functional Materials*, vol. 23, pp. 5326–5333, 2013.
- [153] T. F. Jaramillo, K. P. Jørgensen, J. Bonde, J. H. Nielsen, S. Horch, I. Chorkendorff, “Identification of active edge sites for electrochemical H₂ evolution from MoS₂ nanocatalysts,” *Science*, vol. 317, pp. 100–102, 2007.
- [154] H. Tributsch, J. C. Bennett, “Electrochemistry and photochemistry of MoS₂ layer crystals. I,” *Journal of Electroanalytical Chemistry*, vol. 81, pp. 97–111, 1977.
- [155] B. Hinnemann, P. G. Moses, J. Bonde, K. P. Jørgensen, J. H. Nielsen, S. Horch, I. Chorkendorff, J. K. Nørskov, “Biomimetic Hydrogen Evolution: MoS₂ Nanoparticles as Catalyst for Hydrogen Evolution,” *Journal of the American Chemical Society*, vol. 127, pp. 5308–5309, 2005.
- [156] G. Wang, J. Yang, J. Park, X. Gou, B. Wang, H. Liu, J. Yao, “Facile Synthesis and Characterization of Graphene Nanosheets,” *The Journal of Physical Chemistry C*, vol. 112, pp. 8192–8195, 2008.
- [157] L. Stobinski, B. Lesiak, A. Malolepszy, M. Mazurkiewicz, B. Mierzwa, J. Zemek, P. Jiricek, I. Bieloshapka “Graphene oxide and reduced graphene oxide studied by the XRD, TEM and electron spectroscopy methods,” *Journal of Electron Spectroscopy and Related Phenomena*, vol. 195, pp. 145–154, 2014.
- [158] A. Kaniyoor, S. Ramaprabhu, “A Raman spectroscopic investigation of graphite oxide derived graphene,” *AIP Advances*, vol. 2, pp. 32183, 2012.
- [159] A. C. Ferrari, “Raman spectroscopy of graphene and graphite: Disorder, electron–phonon coupling, doping and nonadiabatic effects,” *Solid State Communications*, vol. 143, pp. 47–57, 2007.
- [160] J. Zhang, H. Yang, G. Shen, P. Cheng, J. Zhang, S. Guo, “Reduction of graphene oxide vial-ascorbic acid,” *Chemical Communications*, vol. 46, pp. 1112–1114, 2010.
- [161] X. Wang, Y. Zhou, J. Zhang, “Se-incorporated Cu-based sulfide nanoparticles for enhanced hydrogen evolution,” *AIP Conference Proceedings*, vol. 2154, pp.020056, 2019.

- [162] P. Joensen, E. D. Crozier, N. A. Alberding, R. F. Frindt, "A study of single-layer and restacked MoS₂ by X-ray diffraction and X-ray absorption spectroscopy," *Journal of Physics C: Solid State Physics*, vol. 20, pp. 4043–4053, 1987.
- [163] H. Deng, C. Zhang, Y. Xie, T. Tumlin, L. Giri, S. P. Karna, J. Lin "Laser induced MoS₂/carbon hybrids for hydrogen evolution reaction catalysts," *Journal of Materials Chemistry A*, vol. 4, pp. 6824–6830, 2016.
- [164] H. Y. Yue, S. S. Song, S. Huang, H. Zhang, X. P. A. Gao, X. Gao, X. Y. Lin, L. H. Yao, E. H. Guan, H. J. Zhang "Preparation of MoS₂-graphene Hybrid Nanosheets and Simultaneously Electrochemical Determination of Levodopa and Uric Acid," *Electroanalysis*, vol. 29, pp. 2565–2571, 2017.
- [165] P. C. Huang, C. L. Wu, S. Brahma, M. O. Shaikh, J. L. Huang, J. J. Lee, S. C. Wang, "MoS₂-carbon inter-overlapped structures as effective electrocatalysts for the hydrogen evolution reaction," *Nanomaterials*, vol. 10, pp. 1–13, 2020.
- [166] Z. T. Shia, W. Kang, J. Xua, Y. W. Suna, M. Jianga, T. W. Ng, H. T. Xue, D. Y. W. Yu, W. Zhang, C. S. Lee, "Hierarchical nanotubes assembled from MoS₂-carbon monolayer sandwiched superstructure nanosheets for high-performance sodium ion batteries," *Nano Energy*, vol. 22, pp. 27–37, 2016.
- [167] P. Fageria, K. Y. Sudharshan, R. Nazir, M. Basu, S. Pande, "Decoration of MoS₂ on g-C₃N₄ surface for efficient hydrogen evolution reaction," *Electrochimica Acta*, vol. 258, pp. 1273–1283, 2017.
- [168] Z. Liu, Z. Gao, Y. Liu, M. Xia, R. Wang, N. Li, "Heterogeneous Nanostructure Based on 1T-Phase MoS₂ for Enhanced Electrocatalytic Hydrogen Evolution," *ACS Applied Materials and Interfaces*, vol. 9, pp. 25291–25297, 2017.
- [169] K. J. Huang, L. Wang, Y. J. Liu, T. Gan, Y. M. Liu, L. L. Wang, Y. Fan, "Synthesis and electrochemical performances of layered tungsten sulfide-graphene nanocomposite as a sensing platform for catechol, resorcinol and hydroquinone," *Electrochimica Acta*, vol. 107, pp. 379–387, 2013.
- [170] Z. Deng, Y. Hu, D. Ren, S. Lin, H. Jiang, C. Li, "Reciprocal hybridization of MoO₂ nanoparticles and few-layer MoS₂ for stable lithium-ion batteries," *Chemical Communications*, vol. 51, pp. 13838–13841, 2015.

- [171] M. A. Lukowski, A. S. Daniel, F. Meng, A. Forticaux, L. Li, and S. Jin, “Enhanced hydrogen evolution catalysis from chemically exfoliated metallic MoS₂ nanosheets,” *Journal of the American Chemical Society*, vol. 135, pp. 10274–10277, 2013. G. Deokar, D. Vignaud, R. Arenal, P. Louette, and J.-F. Colomer, “Synthesis and characterization of MoS₂ nanosheets,” *Nanotechnology*, vol. 27, p. 75604, 2016.
- [172] G. Deokar, D. Vignaud, R. Arenal, P. Louette, and J.-F. Colomer, “Synthesis and characterization of MoS₂ nanosheets,” *Nanotechnology*, vol. 27, p. 75604, 2016.
- [173] D. Wang, Z. Pan, Z. Wu, Z. Wang, and Z. Liu, “Hydrothermal synthesis of MoS₂ nanoflowers as highly efficient hydrogen evolution reaction catalysts,” *Journal of Power Sources*, vol. 264, pp. 229–234, 2014.
- [174] S. Han, K. Liu, L. Hu, F. Teng, P. Yu, Y. Zhu, “Superior Adsorption and Regenerable Dye Adsorbent Based on Flower-Like Molybdenum Disulfide Nanostructure,” *Scientific Reports*, vol. 7, pp. 1–11, 2017.
- [175] H. K. Sadhanala, S. Senapati, K. V. Harika, K. K. Nanda, A. Gedanken, “Green synthesis of MoS₂ nanoflowers for efficient degradation of methylene blue and crystal violet dyes under natural sun light conditions,” *New Journal of Chemistry*, vol. 42, pp. 14318–14324, 2018.
- [176] S. Liu, X. Zhang, H. Shao, J. Xu, F. Chen, Y. Feng, “Preparation of MoS₂ nanofibers by electrospinning,” *Materials Letters*, vol. 73, pp. 223–225, 2012.
- [177] Z. Liu, Z. Gao, Y. Liu, M. Xia, R. Wang, N. Li, “Heterogeneous Nanostructure Based on 1T-Phase MoS₂ for Enhanced Electrocatalytic Hydrogen Evolution,” *ACS Applied Materials & Interfaces*, vol. 9, pp. 25291–25297, 2017.
- [178] C. P. Veeramalai, F. Li, Y. Liu, Z. Xu, T. Guo, T. W. Kim, “Enhanced field emission properties of molybdenum disulfide few layer nanosheets synthesized by hydrothermal method,” *Applied Surface Science*, vol. 389, pp. 1017–1022, 2016.
- [179] M. A. Pimenta, E. D. Corro, B. R. Carvalho, C. Fantini, L. M. Malard, “Comparative study of raman spectroscopy in graphene and MoS₂-type transition metal dichalcogenides,” *Accounts of Chemical Research*, vol. 48, pp. 41–47, 2015.

- [180] D. Wang, Z. Pan, Z. Wu, Z. Wang, Z. Liu, “Hydrothermal synthesis of MoS₂ nanoflowers as highly efficient hydrogen evolution reaction catalysts,” *Journal of Power Sources*, vol. 264, pp. 229–234, 2014.
- [181] M. Majdoub, “MoS₂ nanosheets / silver nanoparticles anchored onto textile fabric as ‘ dip catalyst ’ for synergistic p -nitrophenol hydrogenation,” *Environmental Science and Pollution Research*, vol. 28, pp. 64674–64686, 2021.
- [182] A. Maiti, S. K. Srivastava, “Ru-Doped CuO/MoS₂Nanostructures as Bifunctional Water-Splitting Electrocatalysts in Alkaline Media,” *ACS Applied Nano Materials*, vol. 4, pp. 7675–7685, 2021.
- [183] F. Maugé, J. Lamotte, N. S. Nesterenko, O. Manoilova, A. A. Tsyganenko, “FT-IR study of surface properties of unsupported MoS₂,” *Catalysis Today*, vol. 70, pp. 271–284, 2001.
- [184] A. S. K. Kumar, S. J. Jiang, J. K. Warchoń, “Synthesis and Characterization of Two-Dimensional Transition Metal Dichalcogenide Magnetic MoS₂@Fe₃O₄ Nanoparticles for Adsorption of Cr(VI)/Cr(III),” *ACS Omega*, vol. 2, pp. 6187–6200, 2017.
- [185] W. Li, G. Liu, J. Li, Y. Wang, L. R. Sandoval, Y. Zhang, Z. Zhang, “Hydrogen evolution reaction mechanism on 2H-MoS₂ electrocatalyst,” *Applied Surface Science*, vol. 498, pp. 143869, 2019.
- [186] Z. Li, J. Ma, Y. Zhou, Z. Yin, Y. Tang, Y. Ma, D. Wang, “Synthesis of sulfur-rich MoS₂ nanoflowers for enhanced hydrogen evolution reaction performance,” *Electrochimica Acta*, vol. 283, pp. 306–312, 2018.
- [187] X. Liu, L. Liu, Y. Wu, Y. Wang, J. Yang, Z. Wang, “Rosette-like MoS₂ nanoflowers as highly active and stable electrodes for hydrogen evolution reactions and supercapacitors,” *RSC Advances*, vol. 9, pp. 13820–13828, 2019.
- [188] Y. Yin, J. Han, Y. Zhang, X. Zhang, P. Xu, Q. Yuan, L. Samad, X. Wang, Y. Wang, Z. Zhang, P. Zhang, X. Cao, B. Song, S. Jin, “Contributions of Phase, Sulfur Vacancies, and Edges to the Hydrogen Evolution Reaction Catalytic Activity of Porous Molybdenum Disulfide Nanosheets,” *Journal of the American Chemical Society*, vol. 138, pp. 7965–7972, 2016.

- [189] H. Wang, C. Tsai, D. Kong, K. Chan, F. A. Pedersen, J. K. Nørskov, Y. Cui, “Transition-metal doped edge sites in vertically aligned MoS₂ catalysts for enhanced hydrogen evolution,” *Nano Research*, vol. 8, pp. 566–575, 2015.
- [190] C. Liu, F. Li, L.-P. Ma, and H.-M. Cheng, “Advanced Materials for Energy Storage,” *Advanced Materials*, vol. 22, pp. 28–62, 2010.
- [191] H. Zhang, G. Cao, Y. Yang, “Carbon nanotube arrays and their composites for electrochemical capacitors and lithium-ion batteries,” *Energy and Environmental Science*, vol. 2, pp. 932–943, 2009.
- [192] Y. Zhai, Y. Dou, D. Zhao, P. F. Fulvio, R. T. Mayes, and S. Dai, “Carbon Materials for Chemical Capacitive Energy Storage,” *Advanced Materials*, vol. 23, pp. 4828–4850, 2011.
- [193] A. C. Ferrari, F. Bonaccorso, V. Fal'ko, K. S. Novoselov, S. Roche, P. Bøggild, S. Borini, F. H. L. Koppens, V. Palermo, N. Pugno, J. A. Garrido, R. Sordan, A. Bianco, L. Ballerini, M. Prato, E. Lidorikis, J. Kivioja, C. Marinelli, T. Ryhänen, A. Morpurgo, J. N. Coleman, V. Nicolosi, L. Colombo, A. Fert, M. G. Hernandez, A. Bachtold, G. F. Schneider, F. Guinea, C. Dekker, M. Barbone, Z. Sun, C. Galiotis, A. N. Grigorenko, G. Konstantatos, A. Kis, M. Katsnelson, L. Vandersypen, A. Loiseau, V. Morandi, D. Neumaier, E. Treossi, V. Pellegrini, M. Polini, A. Tredicucci, G. M. Williams, B. H. Hong, J. H. Ahn, J. M. Kim, H. Zirath, B. J. V. Wees, H. V. D. Zant, L. Occhipinti, A. D. Matteo, I. A. Kinloch, T. Seyller, E. Quesnel, X. Feng, K. Teo, N. Rupesinghe, P. Hakonen, S. R. T. Neil, Q. Tannock, T. Löfwanderaq, J. Kinaretba “Science and technology roadmap for graphene, related two-dimensional crystals, and hybrid systems,” *Nanoscale*, vol. 7, pp. 4598-4810, 2015.
- [194] F. Bonaccorso, L. Colombo, G. Yu, M. Stoller, V. Tozzini, A. C. Ferrari, R. S. Ruoff, V. Pellegrini, “Graphene, related two-dimensional crystals, and hybrid systems for energy conversion and storage,” *Science*, vol. 347, 2015.
- [195] B. Hu, K. Wang, L. Wu, S. H. Yu, M. Antonietti, M. M. Titirici, “Engineering carbon materials from the hydrothermal carbonization process of biomass,” *Advanced Materials*, vol. 22, pp. 813–828, 2010.

- [196] C. Meng, O. Z. Gall, P. P. Irazoqui, “A flexible super-capacitive solid-state power supply for miniature implantable medical devices,” *Biomedical Microdevices*, vol. 15, pp. 973–983, 2013.
- [197] S. Faraji, F. N. Ani, “The development supercapacitor from activated carbon by electroless plating-A review,” *Renewable and Sustainable Energy Reviews*, vol. 42, pp. 823–834, 2015.
- [198] A. Borenstein, O. Hanna, R. Attias, S. Luski, T. Brousse, D. Aurbach, “Carbon-based composite materials for supercapacitor electrodes: a review,” *Journal of Materials Chemistry A*, vol. 5, pp. 12653–12672, 2017.
- [199] B. Zheng, T. Huang, L. Kou, X. Zhao, K. Gopalsamy, C. Gao, “Graphene fiber-based asymmetric micro-supercapacitors,” *Journal of Materials Chemistry A*, vol. 2, pp. 9736–9743, 2014.
- [200] M. Zhi, C. Xiang, J. Li, M. Li, N. Wu, “Nanostructured carbon-metal oxide composite electrodes for supercapacitors: A review,” *Nanoscale*, vol. 5, pp. 72–88, 2013.
- [201] K. Wang, H. Wu, Y. Meng, Z. Wei, “Conducting Polymer Nanowire Arrays for High Performance Supercapacitors,” *Small*, vol. 10, no. 1, pp. 14–31, Jan. 2014.
- [202] S. Chen, J. Zhu, X. Wu, Q. Han, X. Wang, “Graphene Oxide–MnO₂ Nanocomposites for Supercapacitors,” *ACS Nano*, vol. 4, pp. 2822–2830, May 2010.
- [203] S. Pei, J. Zhao, J. Du, W. Ren, and H.-M. Cheng, “Direct reduction of graphene oxide films into highly conductive and flexible graphene films by hydrohalic acids,” *Carbon*, vol. 48, pp. 4466–4474, 2010.
- [204] B. Shen, D. Lu, W. Zhai, W. Zheng, “Synthesis of graphene by low-temperature exfoliation and reduction of graphite oxide under ambient atmosphere,” *Journal of Materials Chemistry C*, vol. 1, pp. 50–53, 2013.
- [205] L. Lai, L. Chen, D. Zhan, L. Sun, J. Liu, S. H. Lim, C. K. Poh, Z. Shen, J. Lin, “One-step synthesis of NH₂-graphene from in situ graphene-oxide reduction and its improved electrochemical properties,” *Carbon*, vol. 49, pp. 3250–3257, 2011.
- [206] Z. Lei, L. Lu, X. S. Zhao, “The electrocapacitive properties of graphene oxide reduced by urea,” *Energy and Environmental Science*, vol. 5, pp. 6391–6399, 2012.

- [207] C. Singh, A. K. Mishra, A. Paul, “Highly conducting reduced graphene synthesis via low temperature chemically assisted exfoliation and energy storage application,” *Journal of Materials Chemistry A*, vol. 3, pp. 18557–18563, 2015.
- [208] Z. Yang, Q. Zheng, H. Qiu, J. LI, J. Yang, “A simple method for the reduction of graphene oxide by sodium borohydride with CaCl₂ as a catalyst,” *New Carbon Materials*, vol. 30, no. 1, pp. 41–47, 2015.
- [209] B. Rajagopalan, J. S. Chung, “Reduced chemically modified graphene oxide for supercapacitor electrode,” *Nanoscale Research Letters*, vol. 9, pp. 1–10, 2014.
- [210] L. Zhang, G. Shi, “Preparation of Highly Conductive Graphene Hydrogels for Fabricating Supercapacitors with High Rate Capability,” *The Journal of Physical Chemistry C*, vol. 115, pp. 17206–17212, Sep. 2011.
- [211] J. Ye, L. Ma, W. Chen, Y. Ma, F. Huang, C. Gao, J. Y. Lee, “Supramolecule-mediated synthesis of MoS₂/reduced graphene oxide composites with enhanced electrochemical performance for reversible lithium storage,” *Journal of Materials Chemistry A*, vol. 3, pp. 6884–6893, 2015.
- [212] M. Saraf, K. Natarajan, A. K. Saini, S. M. Mobin, “Small biomolecule sensors based on an innovative MoS₂-rGO heterostructure modified electrode platform: A binder-free approach,” *Dalton Transactions*, vol. 46, pp. 15848–15858, 2017.
- [213] Y. Yang, H. Fei, G. Ruan, C. Xiang, J. M. Tour, “Edge-Oriented MoS₂ Nanoporous Films as Flexible Electrodes for Hydrogen Evolution Reactions and Supercapacitor Devices,” *Advanced Materials*, vol. 26, pp. 8163–8168, Dec. 2014.
- [214] B. Hu, X. Qin, A. M. Asiri, K. A. Alamry, A. O. Al-Youbi, X. Sun, “Synthesis of porous tubular C/MoS₂ nanocomposites and their application as a novel electrode material for supercapacitors with excellent cycling stability,” *Electrochimica Acta*, vol. 100, pp. 24–28, 2013.
- [215] A. Ramadoss, T. Kim, G. S. Kim, S. J. Kim, “Enhanced activity of a hydrothermally synthesized mesoporous MoS₂ nanostructure for high performance supercapacitor applications,” *New Journal of Chemistry*, vol. 38, no. 6, pp. 2379–2385, 2014.

- [216] S. S. Karade, D. P. Dubal, and B. R. Sankapal, "MoS₂ ultrathin nanoflakes for high performance supercapacitors: Room temperature chemical bath deposition (CBD)," *RSC Advances*, vol. 6, pp. 39159–39165, 2016.
- [217] R. Raccichini, A. Varzi, S. Passerini, B. Scrosati, "The role of graphene for electrochemical energy storage," *Nature Materials*, vol. 14, pp. 271–279, 2015.
- [218] A. Moysowicz, G. Gryglewicz, "Hydrothermal-assisted synthesis of a porous polyaniline/reduced graphene oxide composite as a high-performance electrode material for supercapacitors," *Composites Part B: Engineering*, vol. 159, pp. 4–12, 2019.
- [219] K.-J. Huang, L. Wang, Y.-J. Liu, H.-B. Wang, Y.-M. Liu, and L.-L. Wang, "Synthesis of polyaniline/2-dimensional graphene analog MoS₂ composites for high-performance supercapacitor," *Electrochimica Acta*, vol. 109, pp. 587–594, 2013.
- [220] K. Krishnamoorthy, G. K. Veerasubramani, S. Radhakrishnan, and S. J. Kim, "Supercapacitive properties of hydrothermally synthesized sphere like MoS₂ nanostructures," *Materials Research Bulletin*, vol. 50, pp. 499–502, 2014.
- [221] F. Barzegar, A. Bello, D. Momodu, M. J. Madito, J. Dangbegnon, and N. Manyala, "Preparation and characterization of porous carbon from expanded graphite for high energy density supercapacitor in aqueous electrolyte," *Journal of Power Sources*, vol. 309, pp. 245–253, 2016.
- [222] W. Wang, S. Guo, I. Lee, K. Ahmed, J. Zhong, Z. Favors, F. Zaera, M. Ozkan, C. S. Ozkan, "Hydrous ruthenium oxide nanoparticles anchored to graphene and carbon nanotube hybrid foam for supercapacitors," *Scientific Reports*, vol. 4, pp. 9–14, 2014.
- [223] B. Pal, S. Yang, S. Ramesh, V. Thangadurai, R. Jose, "Electrolyte selection for supercapacitive devices: A critical review," *Nanoscale Advances*, vol. 1, pp. 3807–3835, 2019.
- [224] W. Si, X. Wu, J. Zhou, F. Guo, S. Zhuo, H. Cui, W. Xing, "Reduced graphene oxide aerogel with high-rate supercapacitive performance in aqueous electrolytes," *Nanoscale Research Letters*, vol. 8, pp. 247, 2013.

- [225] K. Krishnamoorthy, G. K. Veerasubramani, P. Pazhamalai, S. J. Kim, “Designing two dimensional nanoarchitected MoS₂ sheets grown on Mo foil as a binder free electrode for supercapacitors,” *Electrochimica Acta*, vol. 190, pp. 305–312, 2016.
- [226] K. Krishnamoorthy, G. K. Veerasubramani, S. Radhakrishnan, S. J. Kim, “Supercapacitive properties of hydrothermally synthesized sphere like MoS₂ nanostructures,” *Materials Research Bulletin*, vol. 50, pp. 499-502, 2014.
- [227] K. J. Huang, J. Z. Zhang, G. W. Shi, Y. M. Liu, “Hydrothermal synthesis of molybdenum disulfide nanosheets as supercapacitors electrode material,” *Electrochimica Acta*, vol. 132, pp. 397–403, 2014.
- [228] K. Thiyagarajan, W. J. Song, H. Park, V. Selvaraj, S. Moon, J. Oh, M. J. Kwak, G. Park, M. Kong, M. Pal, J. Kwak, A. Giri, J. H. Jang, S. Park, U. Jeong, “Electroactive 1T-MoS₂ Fluoroelastomer Ink for Intrinsically Stretchable Solid-State In-Plane Supercapacitors,” *ACS Applied Materials & Interfaces*, vol. 13, pp. 26870–26878, 2021.
- [229] X. Wang, W. Ding, H. Li, H. Li, S. Zhu, X. Zhu, J. Dai, Z. Sheng, H. Wang, X. Zhu, Y. Sun, S. X. Dou, “Unveiling highly ambient-stable multilayered 1T-MoS₂ towards all-solid-state flexible supercapacitors,” *Journal of Materials Chemistry A*, vol. 7, no. 32, pp. 19152–19160, 2019.
- [230] S. S. Karade, S. Lalwani, J. H. Eum, H. Kim, “Coin cell fabricated symmetric supercapacitor device of two-steps synthesized V₂O₅ Nanorods,” *Journal of Electroanalytical Chemistry*, vol. 864, p. 114080, 2020.
- [231] X. Wang, W. Ding, H. Li, H. Li, S. Zhu, X. Zhu, J. Dai, Z. Sheng, H. Wang, X. Zhu, Y. Sun, S. X. Dou, “Unveiling highly ambient-stable multilayered 1T-MoS₂ towards all-solid-state flexible supercapacitors,” *Journal of Materials Chemistry A*, vol. 7, pp. 19152–19160, 2019.
- [232] Z. S. Wu, A. Winter, L. Chen, Y. Sun, A. Turchanin, X. Feng, K. Müllen, “Three-Dimensional Nitrogen and Boron Co-doped Graphene for High-Performance All-Solid-State Supercapacitors,” *Advanced Materials*, vol. 24, pp. 5130–5135, Sep. 2012.
- [233] S. Wang, B. Pei, X. Zhao, R. A. W. Dryfe, “Highly porous graphene on carbon cloth as advanced electrodes for flexible all-solid-state supercapacitors,” *Nano Energy*, vol. 2, pp. 530–536, 2013.

- [234] N. Joseph, P. Muhammed Shafi, A. Chandra Bose, “Metallic 1T-MoS₂ with defect induced additional active edges for high performance supercapacitor application,” *New Journal of Chemistry*, vol. 42, pp. 12082–12090, 2018.
- [235] C. Zhou, J. Wang, X. Yan, X. Yuan, D. Wang, Y. Zhu, X. Chenga, “Vertical MoS₂ nanosheets arrays on carbon cloth as binder-free and flexible electrode for high-performance all-solid-state symmetric supercapacitor,” *Ceramics International*, vol. 45, pp. 21534–21543, 2019.
- [236] A. Moyseowicz, G. Gryglewicz, “Hydrothermal-assisted synthesis of a porous polyaniline/reduced graphene oxide composite as a high-performance electrode material for supercapacitors,” *Composites Part B: Engineering*, vol. 159, pp. 4–12, 2019.
- [237] E. Redondo, L. W. Le Fevre, R. Fields, R. Todd, A. J. Forsyth, R. A. W. Dryfe, “Enhancing supercapacitor energy density by mass-balancing of graphene composite electrodes,” *Electrochimica Acta*, vol. 360, p. 136957, 2020.
- [238] P. K. Katkar, S. J. Marje, S. S. Pujari, S. A. Khalate, A. C. Lokhande, U. M. Patil, “Enhanced Energy Density of All-Solid-State Asymmetric Supercapacitors Based on Morphologically Tuned Hydrous Cobalt Phosphate Electrode as Cathode Material,” *ACS Sustainable Chemistry & Engineering*, vol. 7, pp. 11205–11218, Jul. 2019
- [239] M. Saraf, K. Natarajan, S. M. Mobin, “Emerging Robust Heterostructure of MoS₂–rGO for High-Performance Supercapacitors,” *ACS Applied Materials & Interfaces*, vol. 10, pp. 16588–16595, May 2018.
- [240] S. Zheng, L. Zheng, Z. Zhu, J. Chen, J. Kang, Z. Huang, D. Yang, “MoS₂ Nanosheet Arrays Rooted on Hollow rGO Spheres as Bifunctional Hydrogen Evolution Catalyst and Supercapacitor Electrode,” *Nano-Micro Letters*, vol. 10, pp. 62, 2018.

List of Patents, Publications, and Book Chapters

List of Patents

1. Electrochemical device for hydrogen production, **Shanu Mishra**, Somesh Sunil Jaiswal, and Ashish Kumar Mishra, Indian Patent Application 202011018312, Date- 29/04/2020.
2. A method of preparing multiwalled carbon nanotubes, **Shanu Mishra**, Somesh Sunil Jaiswal and Ashish Kumar Mishra, Indian Patent Application 202011017647, Date- 24/04/2020.

List of Publications

1. **Shanu Mishra**, Bishnu Pada Majee, Prince Kumar Maurya and Ashish Kumar Mishra, Multifunctional low temperature reduced graphite oxides for high performance supercapacitors and SERS applications, **Materials Research Express** **6 (2019) 085527**.
2. **Shanu Mishra**, Prince Kumar Maurya and Ashish Kumar Mishra, 2H-MoS₂ nanoflowers with exposed edges for hydrogen producing electrochemical cell, **Materials Today Communications**, **25 (2020), 101270**.
3. **Shanu Mishra**, Prince Kumar Maurya and Ashish Kumar Mishra, 2H-MoS₂ nanoflowers based high energy density solid state Supercapacitor **Materials Chemistry and Physics**, **255 (2020) 123551**.
4. **Shanu Mishra**, Prince Kumar Maurya and Ashish Kumar Mishra, Hydrothermally synthesized MoS₂ nanoclusters for hydrogen evolution reaction, **Electroanalysis** **32 (2020) 2564**.
5. **Shanu Mishra**, Sweta Kumari, and Ashish Kumar Mishra, Polymer derived carbon nanostructure electrodes for solid-state supercapacitor, **Journal of Solid-State Science and Technology**, **11 (2022) 043003**.
6. **Shanu Mishra**, Somesh Sunil Jaiswal, and Ashish Kumar Mishra, Multi-walled carbon nanotubes grown over green iron nanocatalyst as electrode for hydrogen

producing electrochemical cell, **Journal of Materials Science: Materials in Electronics**, **33 (2022) 8702**.

7. Bishnu Pada Majee, **Shanu Mishra**, Rajiv Kumar Pandey, Rajiv Prakash, and Ashish Kumar Mishra, Multifunctional few layers mos₂ for photodetection and SERS application with ultrasensitive and repeated detectability, **Journal of Physical Chemistry C**, **123 (2019) 17071**.

Book Chapter

1. **Shanu Mishra** and Ashish Kumar Mishra, Chapter 4- Supercapacitor: carbon based nanostructures for supercapacitor application, **Book- Book-Nanomaterials & Sustainable Energy Applications**, **Publisher -CRC Press, Taylor & Francis Group, 2021 (Accepted)**.

Schools/Workshops/Conferences Attended

1. **Shanu Mishra**, Ashish Kumar Mishra, Synthesis of MoS₂ via Chemical Route for Supercapacitor Application' (MMISLIBS-II), National Conference on Advanced Nanomaterials and their Applications, MNNIT, Allahabad, India, **December 2018 (Poster presentation)**.
2. **Shanu Mishra**, Ashish Kumar Mishra, Capacitive performance of chemically derived reduced graphene oxide samples 3rd National Conference on Materials for Energy Conversion and Storage in IIT (BHU) Varanasi, India, **15-16 September 2018, (Poster presentation)**.
3. **Shanu Mishra**, Ashish Kumar Mishra, Hydrothermally Synthesized MoS₂ Nanostructure for Supercapacitor Application International Conference on Advanced Materials Jamia Millia Islamia, New Delhi, **February 2019 (Poster Presentation)**.
4. **Shanu Mishra**, Ashish Kumar Mishra, Hydrothermally Synthesized MoS₂ Nanoclusters for Hydrogen Evolution Reaction, **International Conference on Electrochemistry (EIHE-2020), Mumbai, India January 2020, (Poster presentation)**.
5. **Shanu Mishra**, Ashish Kumar Mishra MoS₂ Nanoflower Based Electrochemical Cell for Hydrogen Production, National Conference on Advance Materials and Nuclear Science (AMNS-2020), Gaya, India, **February 2020, (Oral presentation)**.
6. **Shanu Mishra**, Ashish Kumar Mishra Multiwalled Carbon Nanotubes Grown Over Iron Nanocatalyst as Electrode for Hydrogen Producing Electrochemical Cell, 6th International Conference on Nanoscience and Nanotechnology (**ICONN-2021 (Virtual Conference) February 2020, (Oral presentation)**).