References

Abdel-Aziz, A. M. Hassan, H. H. and Badr, I. H. A. "Activated glassy carbon electrode as an electrochemical sensing platform for the determination of 4-nitrophenol and dopamine in real samples", *ACS omega*, **7(38)** (2022), 34127-34135.

Adarakatti, P. S. and Kempahanumakkagari, S. K. "Modified electrodes for sensing". *Electrochemistry*, **15** (2018) 58-95.

Alaejos, M. S. and Garcia Montelongo, F. J. "Application of amperometric biosensors to the determination of vitamins and α-amino acids", *Chemical Reviews*, **104(7)** (2004) 3239-3266.

Aldewachi, H. Chalati, T. Woodroofe, M. N. Bricklebank, N. Sharrack, B. and Gardiner, P. "Gold nanoparticle-based colorimetric biosensors", *Nanoscale*, **10(1)** (2018) 18-33.

Ali, A. Mangrio, F. A. Chen, X. Dai, Y. Chen, K. Xu, X. Xia, R. and Zhu, L. "Ultrathin MoS_2 nanosheets for high-performance photoelectrochemical applications via plasmonic coupling with Au nanocrystals", *Nanoscale*, **11(16)** (2019) 7813-7824.

Aliyev, E. Filiz, V. Khan, M. M. Lee, Y. J. Abetz, C. and Abetz, V. "Structural characterization of graphene oxide: Surface functional groups and fractionated oxidative debris", *Nanomaterials*, **9(8)** (2019) 1180.

Alkahtani, S. A. Mahmoud, A. M. and El-Wekil, M. M. "Electrochemical sensing of copper-chelator D-penicillamine based on complexation with gold nanoparticles modified copper based-metal organic frameworks", *Journal of Electroanalytical Chemistry*, **908** (2022) 116102.

Arguelho, M. L. P. M. Zanoni, M. V. B. and Stradiotto, N. R. "Electrochemical oxidation and voltammetric determination of the antimalaria drug primaquine", *Analytical Letters*,**38(9)** (2005) 1415–1425.

Asadian, E. and Shahrokhian, S. "Voltammetric studies of Azathioprine on the surface of graphite electrode modified with graphene nanosheets decorated with Ag nanoparticles", *Materials Science and Engineering: C*, **58** (2016) 1098-1104.

Baghbamidi, S. E. Beitollahi, H. Tajik, S. and Hosseinzadeh, R. "Voltammetric sensor based on 1-benzyl-4-ferrocenyl-1H-[1, 2, 3]-triazole/carbon nanotube modified glassy

carbon electrode; detection of hydrochlorothiazide in the presence of propranol", *International Journal of Electrochemical Science*, **11(12)** (2016) 10874-10883.

Bai, H. Xu, Y. Zhao, L. Li, C. and Shi, G. "Non-covalent functionalization of graphene sheets by sulfonated polyaniline", *Chemical Communications*, **(13)** (2009) 1667-1669.

Bandodkar, A. J. and Wang, J. "Non-invasive wearable electrochemical sensors: a review", *Trends in Biotechnology*, **32(7)** (2014) 363-371.

Banica, F. G. "*Chemical Sensors and Biosensors: Fundamentals and Applications"*, John Wiley & Sons, ISBN: 978-0-470-71066-1, (2012).

Bashir, S. and Liu, J. "Nanomaterials and their application", *Advanced Nanomaterials and Their Applications in Renewable Energy; Elsevier Inc.: Amsterdam, The Netherlands*, (2015)1-50 ISBN: 978-0-12-801528-5.

Becerril, H. A. Mao, J. Liu, Z. Stoltenberg, R. M. Bao, Z. and Chen, Y. "Evaluation of solution-processed reduced graphene oxide films as transparent conductors", *ACS Nano*, **2(3)** (2008) 463-470.

Beutler, G. E. "The genetics of glucose-6-phosphate dehydrogenase deficiency", *Seminars in Hematology*, **27(2)** (1990) 137-164.

Briggs, D. Wagner, C. D. Riggs, W. M. Davis, L. E. Moulder, J. F. and Muilenberg, G. E."Handbook of X-ray Photoelectron Spectroscopy, Perkin-Elmer Corp., Physical Electronics Division, Eden Prairie, Minnesota, USA", *Surface and Interface Analysis*, **3(4)** (1981) 190.

Brunette, G. W. "*CDC health information for international travel: the yellow book 2018*", *Oxford University Press* (2017).

Catania, F. Marras, E. Giorcelli, M. Jagdale, P. Lavagna, L. Tagliaferro, A. and Bartoli, M. "A review on recent advancements of graphene and graphene-related materials in biological applications", *Applied Sciences*, **11(2)** (2021) 614.

Chaki, N. K. Sudrik, S. G. Sonawane, H. R. and Vijayamohanan, K. "Single phase preparation of monodispersed silver nanoclusters using a unique electron transfer and cluster stabilising agent, triethylamine", *Chemical Communications*, **(1)** (2002) 76-77.

References

Chalmers, A. H. "A spectrophotometric method for the estimation of urinary azathioprine, 6-mercaptopurine, and 6-thiouric acid", *Biochemical Medicine,* **12(3)** (1975) 234-241.

Chang, K. and Chen, W. "L-cysteine-assisted synthesis of layered MoS_2/graphene composites with excellent electrochemical performances for lithium ion batteries". *ACS Nano,* **5(6)** (2011) 4720-4728.

Chao, J. Han, X. Sun, H. Su, S. Weng, L. and Wang, L. Platinum nanoparticles supported MoS_2nanosheet for simultaneous detection of dopamine and uric acid", *Science China Chemistry,* **59(3)**(2016) 332-337.

Chen, H. Y. Wang, J. Meng, L. Yang, T. and Jiao, K. "Thin-layered MoS_2/polyaniline nanocomposite for highly sensitive electrochemical detection of chloramphenicol", *Chinese Chemical Letters,* **27(2)** (2016) 231-234.

Chen, J. C. Shih, J. L. Liu, C. H. Kuo, M. Y. and Zen, J. M. "Disposable electrochemical sensor for determination of nitroaromatic compounds by a single-run approach", *Analytical Chemistry,* **78(11)** (2006) 3752-3757.

Chen, K. Chou, W. Liu, L. Cui, Y. Xue, P. andJia, M. "Electrochemical sensors fabricated by electrospinning technology: An overview", *Sensors*, **19(17)** (2019) 3676.

Chen, M. Su, H. Mao, L. Guo, M. and Tang, J. "Highly sensitive electrochemical DNA sensor based on the use of three-dimensional nitrogen-doped graphene", *Microchimica Acta,* **185(1)** (2018) 1-9.

Chen, S. P. Qiao, Z. Vivoni, A. and Hosten, C. M. "Determination of the orientation of azathioprine adsorbed on a silver electrode by SERS and ab initio calculations", *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy,* **59(12)** (2003) 2905-2914.

Chen, Y. Fan, Z. Zhang, Z. Niu, W. Li, C. Yang, N. Chen, B. and Zhang, H. "Two-dimensional metal nanomaterials: synthesis, properties, and applications", *Chemical Reviews,* **118(13)** (2018) 6409-6455.

References

Chen, Z. Cummins, D. Reinecke, B. N. Clark, E. Sunkara, M. K. and Jaramillo, T. F. "Core–shell MoO_3–MoS_2 nanowires for hydrogen evolution: a functional design for electrocatalytic materials", *Nano letters,* **11(10)** (2011) 4168-4175.

Chhowalla, M. Shin, H. S. Eda, G. Li, L. J. Loh, K. P. and Zhang, H. "The chemistry of two-dimensional layered transition metal dichalcogenidenanosheets", *Nature Chemistry,* **5(4)** (2013) 263-275.

Chimene, D. Alge, D. L. and Gaharwar, A. K. "Two-dimensional nanomaterials for biomedical applications: emerging trends and future prospects", *Advanced Materials,* **27(45)** (2015) 7261-7284.

Clyde, D. F. "Clinical problems associated with the use of primaquine as a tissue schizontocidal and gametocytocidal drug", *Bulletin of the World Health Organization,* **59(3)** (1981) 391-395.

Croes, K. McCarthy, P. T. and Flanagan, R. J. "Simple and rapid HPLC of quinine, hydroxychloroquine, chloroquine, and desethylchloroquine in serum, whole blood, and filter paper-adsorbed dry blood", *Journal of Analytical Toxicology,* **18(5)** (1994) 255-260.

Dadkhah, S. Ziaei, E. Mehdinia, A. Kayyal, T. B. and Jabbari, A. "A glassy carbon electrode modified with amino-functionalized graphene oxide and molecularly imprinted polymer for electrochemical sensing of bisphenol A", *Microchimica Acta,* **183(6)** (2016) 1933-1941.

Dang, Y. Q. Ren, S. Z. Liu, G. Cai, J. Zhang, Y. and Qiu, J. "Electrochemical and capacitive properties of carbon dots/reduced graphene oxide supercapacitors", *Nanomaterials,* **6(11)** (2016), 212.

Daniloska, V. Keddie, J. L. Asua, J. M. and Tomovska, R. "MoS_2 Nanoplatelet Fillers forEnhancement of the Properties of Waterborne Pressure Sensitive Adhesives", *ACS Applied Materials & Interfaces,* **6(24)**(2010) 22640-22648.

Davadra, P. M. Mepal, V. V. Jain, M. R. Joshi, C. G. and Bapodra, A. H. "A validated UPLC method for the determination of process-related impurities in Azathioprine bulk drug", *Analytical Methods,* **3(1)** (2011) 198-204.

References

David, B. W. and Carter, C. B. “Transmission electron microscopy: A textbook for materials science”, *Springer Science+ Business Media*, LLC(1996).

Dervieux, T. and Boulieu, R. “Simultaneous determination of 6-thioguanine and methyl 6-mercaptopurine nucleotides of azathioprine in red blood cells by HPLC”, *Clinical Chemistry*, **44(3)** (1998) 551-555.

Ding, J. Sun, W. Wei, G. and Su, Z. “Cuprous oxide microspheres on graphene nanosheets: an enhanced material for non-enzymatic electrochemical detection of H_2O_2 and glucose”, *RSC Advances*, **5(44)** (2015) 35338-35345.

Dolinska, J. Chidambaram, A. Taleat, Z. Adamkiewicz, W. Lisowski, W. Palys, B. Holdynski, M. Andryszewski, T. Sashuk, V. Rassaei, L. and Opallo, M. “Decoration of MoS_2 nanopetal stacks with positively charged gold nanoparticles for synergistic electrocatalytic oxidation of biologically relevant compounds”, *Electrochimica Acta*, **182** (2015) 659-667.

Du, J. Hu, X. Zhang, G, Wu, X. and Gong, D. “Colorimetric detection of cadmium in water using L-cysteine functionalized gold–silver nanoparticles”, *Analytical Letters*, **51(18)** (2018) 2906-2919.

Du, Y. Zhao, Y. Qu, Y. Chen, C. H. Chen, C. M. Chuang, C. H. and Zhu, Y. “Enhanced light–matter interaction of graphene–gold nanoparticle hybrid films for high-performance SERS detection”, *Journal of Materials Chemistry C*, **2(23)** (2014) 4683-4691.

Dubey, P. Kumar, A. and Prakash, R. “Non-covalent functionalization of graphene oxide by polyindole and subsequent incorporation of Ag nanoparticles for electrochemical applications”, *Applied Surface Science*, **355** (2015) 262-267.

Ducharme, J. and Farinotti, R. “Rapid and simple method to determine chloroquine and its desethylated metabolites in human microsomes by high-performance liquid chromatography with fluorescence detection”, *Journal of Chromatography B: Biomedical Sciences and Applications*, **698(1-2)** (1997) 243-250.

Dwivedi, A. K. Saxena, D. and Singh, S. “HPLC and HPTLC assays for the antimalarial agents Chloroquine, Primaquine and Bulaquine”, *Journal of Pharmaceutical and Biomedical Analysis*,**33(4)** (2003) 851-858.

References

Edgar, J. A. McDonagh, A. M.andCortie, M. B. “Formation of gold nanorods by a stochastic “popcorn” mechanism” *ACS nano*, **6(2)** (2012) 1116-1125.

Elgrishi, N. Rountree, K. J. McCarthy, B. D. Rountree, E. S. Eisenhart, T. T. and Dempsey, J. L. “A practical beginner’s guide to cyclic voltammetry”, *Journal of Chemical Education*, **95(2)** (2018) 197-206.

Ensafi, A. A. Ahmadi, Z. Jafari-Asl, M. and Rezaei, B. “Graphene nanosheets functionalized with Nile blue as a stable support for the oxidation of glucose and reduction of oxygen based on redox replacement of Pd-nanoparticles via nickel oxide”, *Electrochimica Acta*,**173** (2015) 619–629.

Er, E. Çelikkan, H. Erk, N. andAksu, M. L. “A new generation electrochemical sensor based on Graphene nanosheets/Gold nanoparticles/Nafion nanocomposite for determination of Silodosin”, *Electrochimica Acta*, **157**(2015) 252-257.

Fadil, Y. Agarwal, V. Jasinski, F. Thickett, S. C. Minami, H. and Zetterlund, P. B. “Electrically conductive polymer/rGO nanocomposite films at ambient temperature via miniemulsion polymerization using GO as surfactant”, *Nanoscale*, **11(14)** (2019) 6566-6570.

Fazio, T. T. Singh, A. K. Kedor-Hackmann, E. R. M. and Santoro, M. I. R. M. “Quantitative determination and sampling of azathioprine residues for cleaning validation in production area”, *Journal of Pharmaceutical and Biomedical Analysis*, **43(4)** (2007) 1495-1498.

Fernando, D. Rodrigo, C. and Rajapakse, S. “Primaquine in vivax malaria: an update and review on management issues”, *Malaria Journal*, **10(1)** (2011) 1-12.

Fishman, J. A. “Treatment of infection due to Pneumocystis carinii”, *Antimicrobial Agents and Chemotherapy*, **42(6)** (1998) 1309-1314.

Fu, H. Chow, H. Lew, M. Menon, S. Scratchley, C. and Parameswaran, M. A. “An Electrochemical Potentiostat Interface for Mobile Devices: Enabling Remote Medical Diagnostics”, arXiv preprint arXiv:1509.08591(2015).

References

Galappaththy, G. N. L. Tharyan, P. and Kirubakaran, R. "Primaquine for preventing relapse in people with Plasmodium vivax malaria treated with chloroquine", *Cochrane Database of Systematic Review,* **10** (2013)

Gan, X. Zhao, H. and Quan, X. "Two-dimensional MoS_2: A promising building block for biosensors", *Biosensors and Bioelectronics,* **89** (2017) 56-71.

Gao, S. Zhang, Y. Yang, Z. Fei, T. Liu, S. and Zhang, T. Electrochemical chloramphenicol sensors-based on trace MoS_2 modified carbon nanomaterials: Insight into carbon supports", *Journal of Alloys and Compounds,* **872**(2021) 159687.

Gedda, G. Pandey, S. Bhaisare, M. L. and Wu, H. F. "Carbon dots as nanoantennas for anti-inflammatory drug analysis using surface-assisted laser desorption/ionization time-of-flight mass spectrometry in serum", *RSC Advances,* **4(72)** (2014) 38027-38033.

Goger, N. G. Parlatan, H. K. Basan, H. Berkkan, A. and Ozden, T. "Quantitative determination of azathioprine in tablets by 1H NMR spectroscopy", *Journal of Pharmaceutical and Biomedical Analysis,* **21(3)** (2000) 685-690.

Goodman, L. S. "Goodman and Gilman's the pharmacological basis of therapeutics", *New York: McGraw-Hill,* **1549** (1996) 1361-1373).

Gopalakrishnan, D. Damien, D. andShaijumon, M. M. "MoS_2 quantum dot-interspersed exfoliated MoS_2nanosheets", *ACS Nano,* **8(5)** (2014) 5297-5303.

Govindasamy, M. Chen, S. M. Mani, V. Devasenathipathy, R. Umamaheswari, R. Santhanaraj, K. J. and Sathiyan, A. "Molybdenum disulfide nanosheets coated multiwalled carbon nanotubes composite for highly sensitive determination of chloramphenicol in food samples milk, honey and powdered milk", *Journal of Colloid and Interface Science,* **485** (2017) 129-136.

Gründler, P. "An introduction for Scientists and Engineers", (2007) ISBN: 978-3-540-45742-8.

Guan, J. F. Zou, J. Liu, Y. P. Jiang, X. Y. and Yu, J. G. "Hybrid carbon nanotubes modified glassy carbon electrode for selective, sensitive and simultaneous detection of dopamine and uric acid", *Ecotoxicology and Environmental Safety,* **201** (2020) 110872.

References

Guo, J. Zhu, H. Sun, Y. Tang, L. and Zhang, X. "Doping MoS_2 with graphene quantum dots: structural and electrical engineering towards enhanced electrochemical hydrogen evolution", *Electrochimica Acta,* **211** (2016) 603-610.

Guo, S. Wen, D. Zhai, Y. Dong, S. and Wang, E. "Platinum Nanoparticle Ensemblenthesus, and Used as New Electrode Material for Electrochemical Sensing", *ACS Nano,* **4** (2010) 3959-3968.

Han, J. Xu, G. Ding, B. Pan, J. Dou, H. and MacFarlane, D. R. "Porous nitrogen-doped hollow carbon spheres derived from polyaniline for high performance supercapacitors", *Journal of Materials Chemistry A,* **2(15)** (2014) 5352-5357.

Harvey, D. "Modern Analytical Chemistry, A Division of the MC–Graw-Hill Companies," 1st Edn, (1956).

Hatami, Z. and Jalali, F. "Voltammetric determination of immunosuppressive agent, azathioprine, by using a graphene-chitosan modified-glassy carbon electrode". *Russian Journal of Electrochemistry,* **51(1)** (2015) 70-76.

Hong, X. Tan, C. Chen, J. Xu, Z. and Zhang, H. "Synthesis, properties and applications of one-and two-dimensional gold nanostructures", *Nano Research,* **8(1)** (2015) 40-55.

Hrapovic, S. Liu, Y. Male, K. B. and Luong, J. H. "Electrochemical biosensing platforms using platinum nanoparticles and carbon nanotubes", *Analytical Chemistry,* **76(4)** (2004) 1083-1088.

Hu, S. Huang, Q. Lin, Y. Wei, C. Zhang, H. Zhang, W. Guo, Z. Bao, X. Shi, J. and Hao, A. "Reduced graphene oxide-carbon dots composite as an enhanced material for electrochemical determination of dopamine", *Electrochimica Acta,* **130** (2014) 805-809.

Hu, T. Mei, X. Wang, Y. Weng, X. Liang, R. and Wei, M. "Two-dimensional nanomaterials: fascinating materials in biomedical field", *Science Bulletin,* **64(22)** (2019) 1707-1727.

Huang, K. J. Wang, L. Li, J. and Liu, Y. M. "Electrochemical sensing based on layered MoS_2–graphene composites", *Sensors and Actuators B: Chemical,* **178**(2013) 671-677.

References

Huang, K. J. Zhang, J. Z.Liu, Y. J.and Wang, L. L. "Novel electrochemical sensing platform based on molybdenum disulfide nanosheets-polyaniline composites and Au nanoparticles", *Sensors and Actuators B: Chemical,* **194**(2014) 303-310.

Huang, X. Tan, C. Yin, Z. and Zhang, H. "25th Anniversary article: hybrid nanostructures based on two-dimensional nanomaterials", *Advanced Materials,* **26(14)**(2014) 2185-2204.

Hulanicki, A. Glab, S. and Ingman, F. "Chemical sensors: definitions and classification", *Pure and applied chemistry,* **63(9)** (1991) 1247-1250.

Immanuel, S. and Sivasubramanian, R. "Electrochemical studies of NADH oxidation on chemically reduced graphene oxide nanosheets modified glassy carbon electrode". *Materials Chemistry and Physics,* **249** (2020) 123015.

Iqbal, M. Z. and Aziz, U. "Supercapattery: Merging of battery-supercapacitor electrodes for hybrid energy storage devices", *Journal of Energy Storage,* **46** (2022) 103823.

Jayabal, S. Viswanathan, P. and Ramaraj, R. "Reduced graphene oxide–gold nanorod composite material stabilized in silicate sol–gel matrix for nitric oxide sensor", *RSC Advances,* **4(63)** (2014) 33541-33548.

Jiao, L. Zhang, L. Wang, X. Diankov, G. and Dai, H. "Narrow graphene nanoribbons from carbon nanotubes", *Nature,* **458(7240)** (2009) 877-880.

John, T. Rani, S. and Hiremath, R. "Colorimetric method for the estimation of primaquine phosphate", *Indian Drugs,* **33(6)** (1996) 293-297.

Joshi, L. and Prakash, R. "Synthesis of conducting poly (5-carboxyindole)/Au nanocomposite: investigation of structural and nanoscale electrical properties", *Thin Solid Films,* **534** (2013) 120-125.

Joshi, L. Gupta, B. and Prakash, R. "Chemical synthesis of poly (5-carboxyindole) and poly (5-carboxyindole)/carboxylated multiwall carbon nanotube nanocomposite", *Thin Solid Films,* **519(1)** (2010) 218-222.

Kakaei, K. "One-pot electrochemical synthesis of graphene by the exfoliation of graphite powder in sodium dodecyl sulfate and its decoration with platinum nanoparticles for methanol oxidation", *Carbon,* **51**(2013) 195-201.

References

Karad, M. D. and Barhate, V. D. "Spectrophotometric determination of an antimalarial drug primaquine in bulk and pharmaceutical formulations", *World Journal of Pharmaceutical Research*, **4(5)** (2015) 2370- 2377.

Keerthana, S. Rajapriya, A.Amirthapandian, S. Viswanathan, C.andPonpandian, N. "WS_2 hierarchical nanoflowers on rGO with enhanced electrochemical performance for sensitive and selective detection of mesalazine in real sample analysis", *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, **618**(2021) 126452.

Khawula, T. N. Raju, K. Franklyn, P. J. Sigalas, I. and Ozoemena, K. I. "Symmetric pseudocapacitors based on molybdenum disulfide (MoS 2)-modified carbon nanospheres: correlating physicochemistry and synergistic interaction on energy storage", *Journal of Materials Chemistry A*, **4(17)** (2016) 6411-6425.

Kim, K. S. Zhao, Y. Jang, H. Lee, S. Y. Kim, J. M. Kim, K. S. Ahn, J. H. Kim, P. Choi, J. Y. and Hong, B. H. "Large-scale pattern growth of graphene films for stretchable transparent electrodes", *Nature*, **457(7230)** (2009) 706-710.

Kimmel, D. W. LeBlanc, G. Meschievitz, M. E. and Cliffel, D. E. "Electrochemical sensors and biosensors", *Analytical Chemistry*, **84(2)** (2012) 685-707.

Kloprogge, J. T. and Wood, B. J. "Handbook of Mineral Spectroscopy: Volume 1: X-ray Photoelectron Spectra", *Elsevier,* (2020).

Kristensen, J. S. Grislingaas, A. L. Greenhill, J. V. Skjetne, T. Karlsen, J. and Tønnesen, H. H. "Photochemical stability of biologically active compounds: V. Photochemical degradation of primaquine in an aqueous medium", *International Journal of Pharmaceutics,***100(1-3)** (1993) 15–23.

Kulkarni, S. Chitalkar, K. Shinde, N. Tekale, P. and Lanjewar, R. "A validated high-performance thin-layer chromatographic method for the determination of azathioprine from pharmaceutical formulation", *JPC-Journal of Planar Chromatography-Modern TLC*, **27(2)** (2014) 120-123.

Kumar, A. and Prakash, R. "Graphene sheets modified with polyindole for electro-chemical detection of dopamine", *Journal of Nanoscience and Nanotechnology*, **14(3)** (2014) 2501-2506.

References

Kumar, B. Bhalla, V. Bhadoriya, R. P. S. Suri, C. R. Varshney, G. C. "Label-free electrochemical detection of malaria-infected red blood cells", *RSC Advances***6** (2016) 75862–75869.

Lakshmi, C. S. and Reddy, M. N. "Spectrophotometric determination of azathioprine in pharmaceutical formulations", *Talanta,* **47(5)** (1998) 1279-1286.

Lam, K. Van Wyck, S. J. and Geiger, W. E. "One-electron oxidation of chloroquine, cymanquine, and related aminoquinolines in nonaqueous media", *Journal of Electroanalytical Chemistry,* **799** (2017) 531-537.

Laursen, A. B. Kgnaes, S. Dahl, S. and Chorkendorff, I. "Molybdenum sulfides-efficient and viable materials for electro- and photoelectrocatalytic hydrogen evolution", *Energy & Environmental Science,* **5(2)**(2012) 5577-5591.

Li, X. and Du, X. "Molybdenum disulfide nanosheets supported Au-Pd bimetallic nanoparticles for non-enzymatic electrochemical sensing of hydrogen peroxide and glucose", *Sensors and Actuators B: Chemical,***239**(2017) 536-543.

Liu, Y. Wang, R. Zhu, Y. Li, R. and Zhang, J. "Photoelectrochemical sensing of catechol based on CdS-DNA-pristine graphene nanocomposite film", *Sensors and Actuators B: Chemical*, **210** (2015) 355-361.

Liu, Z. Liu, Q. Huang, Y. Ma, Y. Yin, S. Zhang, X. Sun, W. and Chen, Y. "Organic photovoltaic devices based on a novel acceptor material: graphene", *Advanced Materials,* **20(20)** (2008) 3924-3930.

López-Lorente, Á. I. "Recent developments on gold nanostructures for surface enhanced Raman spectroscopy: Particle shape, substrates and analytical applications. A review", *Analytica Chimica Acta,* **1168** (2021): 338474.

Maduraiveeran, G. Sasidharan, M. and Ganesan, V. "Electrochemical sensor and biosensor platforms based on advanced nanomaterials for biological and biomedical applications", *Biosensors and Bioelectronics,* **103**(2018) 113-129.

Mall, V. K., Ojha, R. P. Tiwari, P. and Prakash P. "Immunosuppressive drug sensor based on MoS_2-polycarboxyindole modified electrodes", *Results in Chemistry,* **4** (2022) 100345.

References

Martins, A. C. Cayotopa, A. D. E. Klein, W. W. Schlosser, A. R. Silva, A. F. D. Souza, M. N. D. Andrade, B. W. B. Filgueira-Júnior, J. A. Pinto, W. D. J. and Silva-Nunes, M. D. "Side effects of Chloroquine and Primaquine and Symptom Reduction in Malaria Endemic Area (Mâncio Lima, Acre, Brazil)", *Interdisciplinary Perspectives on Infectious Diseases* (2015).

Mashhadizadeh, M. H. and Akbarian, M. "Voltammetric determination of some anti-malarial drugs using a carbon paste electrode modified with Cu $(OH)_2$ nano-wire", *Talanta*, **78(4-5)** (2009) 1440-1445.

Mathur, N. C. Goyal, R. N. and Malik, W. U. "Oxidation of 2-aminoquinoline at a stationary pyrolytic graphite electrode", *Analytica Chimica Acta*, **230** (1990) 91-96.

McCoy, T. M. Turpin, G. Teo, B. M. and Tabor, R. F. "Graphene oxide: a surfactant or particle?",*Current Opinion in Colloid & Interface Science*, **39** (2019) 98-109.

McLeod, H. L. and Siva, C. "The thiopurine S-methyltransferase gene locus–implications for clinical pharmacogenomics", *Pharmacogenomics*, **3(1)** (2002) 89-98.

Mehrabi, A. Rahimnejad, M. Mohammadi, M. and Pourali, M. "Electrochemical detection of Flutamide as an anticancer drug with gold nanoparticles modified glassy carbon electrode in the presence of prostate cancer cells", *Journal of Applied Electrochemistry*, **51(4)** (2021) 597-606.

Meng, Y. Aldous, L. Belding, S. R. and Compton, R. G. "The formal potentials and electrode kinetics of the proton/hydrogen couple in various room temperature ionic liquids", *Chemical Communications*, **48(45)** (2012) 5572-5574.

Miranda, T. A. Silva, P. H. R. Pianetti, G. A. and Cesar, I. C. "Simultaneous quantitation of chloroquine and primaquine by UPLC-DAD and comparison with a HPLC-DAD method", *Malarial Journal*, **14(1)** (2015) 1-7.

Mishra, R. Nirala, N. R. Pandey, R. K. Ojha, R. P. and Prakash, R. "Homogenous dispersion of MoS_2 nanosheets in polyindole matrix at air–water interface assisted by Langmuir technique", *Langmuir*, **33(47)** (2017) 13572-13580.

References

Mitragotri, S. Anderson, D. G. Chen, X. Chow, E. K. Ho, D. Kabanov, A. V. Karp, J. M. Kataoka, K. Mirkin, C. A. Petrosko, S. H. Shi, J. Stevens, M. M. Sun, S. Teoh, S. Venkatraman, S. S. Xia, Y. Wang, S. Gu, Z. and Xu, C. "Accelerating the translation of nanomaterials in biomedicine", *ACS Nano*, **9(7)** (2015) 6644-6654.

Mohanta, D. "A DETAILED STUDY ON OPTICAL AND PHYSICAL PROPERTIES OF RICE AND ITS BY-PRODUCTS" (Doctoral dissertation, Tezpur University) (2017).

Mouri, S. Miyauchi, Y. and Matsuda, K. "Tunable photoluminescence of monolayer MoS_2 via chemical doping", *Nano letters*, **13(12)** (2013) 5944-5948.

Muduli, S. Naresh, V. Pati, S. K. Duary, S. and Martha, S. K. "Polypyrrole-MoS_2nanopetals as efficient anode material for lead-based hybrid ultracapacitors", *Journal of The Electrochemical Society*, **168(5)** (2021) 050523.

Mueller, X. M. "Drug immunosuppression therapy for adult heart transplantation. Part 1: immune response to allograft and mechanism of action of immunosuppressants", *The Annals of Thoracic Surgery*, **77(1)** (2004) 354-362.

Muhm, M. Stimpfl, T. Malzer, R. Mortinger, H. Binder, R. Vycudilik, W. Berzlanovich, A. Bauer, G. and Laggner, A. N. "Suicidal chloroquine poisoning: clinical course, autopsy findings, and chemical analysis", *Journal of Forensic Science*, **41(6)** (1996) 1077-1079.

Murugan, E. and Dhamodharan, A. "MoS_2/PANI/f-MWCNTs ternary nanocomposite modified electrode for selective and concomitant sensing of vanillin, theophylline and caffeine", *Diamond and Related Materials*, **128**(2022) 109268.

Murugan, E. Dhamodharan, A. and Saranya, S. "PANI blended MoS_2 decorated GO ternary nanocomposite for efficient electrochemical sensing of crucial components in food and beverages", *Indian Journal of Chemical Technology*, **28** (2021) 518-527.

Na-Bangchang, K. Guirou, E. A. Cheomung, A. and Karbwang, J. "Determination of Primaquine in Whole Blood and Finger-Pricked Capillary Blood Dried on Filter Paper Using HPLC and LCMS/MS", *Chromatographia*, **77(7)** (2014) 561-569.

References

Nagib Qarah, A. S. Basavaiah, K. and Swamy, N. "Sensitive and selective extraction-free spectrophotometric assay of chloroquine phosphate in pharmaceuticals based on ion-pair reaction with bromocresol green and bromocresol purple", *Pharmaceutica Analytica Acta*, **8(539)** (2017) 2-10.

Nate, Z. Gill, A. A. Chauhan, R. and Karpoormath, R. "Polyaniline-cobalt oxide nanofibers for simultaneous electrochemical determination of antimalarial drugs: Primaquine and proguanil", *Microchemical Journal,* **160** (2021) 105709.

Neto, A. C. Guinea, F. Peres, N. M. Novoselov, K. S. and Geim, A. K. "The electronic properties of graphene", *Reviews of Modern Physics,* **81(1)** (2009) 109.

Nikhil, S. Karthika, A. Suresh, P. Suganthi, A. and Rajarajan, M. "A selective and sensitive electrochemical determination of catechol based on reduced graphene oxide decorated β-cyclodextrinnanosheet modified glassy carbon electrode", *Advanced Powder Technology,* **32(7)** (2021) 2148-2159.

Novoselov, K. S. Geim, A. K. Morozov, S. V. Jiang, D. E. Zhang, Y. Dubonos, S. V. Grigorieva, I.V, and Firsov, A. A. "Electric field effect in atomically thin carbon films", *Science,* **306(5696)** (2004) 666-669.

Ojha, R. P. Singh, P. Azad, U. P. and Prakash, R. "Impedimetric immunosensor for the NS1 dengue biomarker based on the gold nanorod decorated graphitic carbon nitride modified electrode", *Electrochimica Acta*, **411** (2022) 140069.

Ostovar, S. Maghsoudi, S. and Mousavi, M. "Development of a sensitive voltammetric sensor for diltiazem determination in biological samples using MWCNT/PPy-PBA modified glassy carbon electrode", *Synthetic Metals,* **281** (2021) 116928.

Pan, M. Yang, J. Liu, K. Yin, Z. Ma, T. Liu, S. Xu, L. and Wang, S. "Noble metal nanostructured materials for chemical and biosensing systems", *Nanomaterials,* **10(2)** (2020) 209.

Pang,H. L. Lu, J. P. Chen, J. H. Huang, C. T. Liu, B. and Zhang, X. H. "Preparation of SnO_2- CNTs supported Pt catalysts and their electrocatalytic properties for ethanol oxidation", *Electrochimica Acta,***54(9)** (2009) 2610–2615.

References

Papadopoulos, K. Triantis, T. Dimotikali, D. and Nikokavouras, J. “Radiostorage-and photostoragechemiluminescence: analytical prospects”, *Analytica Chimica Acta,* **423(2)** (2000) 239-245.

Park, S. and Ruoff, R. S. “Chemical methods for the production of graphenes”, *Nature Nanotechnology,* **4(4)** (2009) 217-224.

Pedrozo-Peñafiel, M. J. Almeida, J. M. Toloza, C. A. Larrudé, D. G. Pacheco, W. F. and Aucelio, R. Q. “Square-wave voltammetric determination of primaquine in urine using a multi-walled carbon nanotube modified electrode” *Microchemical Journal,* **150** (2019) 104201.

Phasuksom, K. Prissanaroon-Ouajai, W. and Sirivat, A. “A highly responsive methanol sensor based on graphene oxide/polyindole composites”, *RSC Advances,* **10(26)** (2020) 15206-15220.

Poh, T. Y. Ali, N. A. B. M. Mac Aogáin, M. Kathawala, M. H.Setyawati, M. I. Ng, K. W. and Chotirmall, S. H. “Inhaled nanomaterials and the respiratory microbiome: clinical, immunological and toxicological perspectives”, *Particle and Fibre Toxicology,* **15** (2018) 1-16.

Prasad, B. B. Kumar, A. and Singh, R. “Molecularly imprinted polymer-based electrochemical sensor using functionalized fullerene as a nanomediator for ultratrace analysis of primaquine”, *Carbon,* **109** (2016) 196–207.

Pumera, M. and Loo, A. H. “Layered transition-metal dichalcogenides (MoS_2 and WS_2) for sensing and biosensing”, *TrAC Trends in Analytical Chemistry,* **61** (2014) 49-53.

Putzbach, W. and Ronkainen, N. J. “Immobilization techniques in the fabrication of nanomaterial-based electrochemical biosensors: A review”. *Sensors,* **13(4)** (2013) 4811-4840.

Radi, A. “Accumulation and trace measurement of chloroquine drug at DNA-modified carbon paste electrode”, *Talanta,* **65(1)** (2005) 271-275.

Rae, W. Burke, G. and Pinto, A. “A study of the utility of azathioprine metabolite testing in myasthenia gravis”, *Journal of Neuroimmunology,* **293** (2016) 82-85.

References

Rafati, A. A. and Afraz, A. "Amperometric sensing of anti-HIV drug zidovudine on Ag nanofilm-multiwalled carbon nanotubes modified glassy carbon electrode", *Materials Science and Engineering: C,* **39** (2014) 105-112.

Raju, V. Kumar, Y. V. N. Jetti, V. R. and Basak, P. "MoS_2/Polythiophene Composite Cathode as a Potential Host for Rechargeable Aluminum Batteries: Deciphering the Impact of Processing on the Performance", *ACS Applied Energy Materials,* **4(9)** (2021) 9227-9239.

Rashed, M. A. Faisal, M. Alsaiari, M. Alsareii, S. A. and Harraz, F. A. "MWCNT-doped polypyrrole-carbon black modified glassy carbon electrode for efficient electrochemical sensing of nitrite ions", *Electrocatalysis,* **12(6)** (2021) 650-666.

Rathee, K. Dhull, V. Dhull, R. and Singh, S. "Biosensors based on electrochemical lactate detection: A comprehensive review", *Biochemistry and biophysics reports,* **5** (2016) 35-54.

Reddy, Y. V. M. Sravani, B.Maseed, H. Łuczak, T.Osińska, M. SubramanyamSarma, L. Srikanth, V. V. S. S. and Madhavi, G. "Ultrafine Pt–Ni bimetallic nanoparticles anchored on reduced graphene oxide nanocomposites for boosting electrochemical detection of dopamine in biological samples", *New Journal of Chemistry*, **42(20)** (2018) 16891-16901.

Regiart, M. Pereira, S. V. Spotorno, V. G. Bertolino, F. A. and Raba, J. "Nanostructured voltammetric sensor for ultra-trace anabolic drug determination in food safety field", *Sensors and Actuators B: Chemical*, **188** (2013) 1241-1249.

Saad, B. Zin, Z. M. Jab, M. S. Ab Rahman, I. Saleh, M. I. and Mahsufi, S. "Flow-through chloroquine sensor and its applications in pharmaceutical analysis", *Analytical Sciences,* **21(5)** (2005) 521-524.

Sajedi-Moghaddam, A. Saievar-Iranizad, E. and Pumera, M. "Two-dimensional transition metal dichalcogenide/conducting polymer composites: synthesis and applications", *Nanoscale,* **9(24**) (2017) 8052-8065.

Sakhuja, N. Gupta, A. Jha, R. and Bhat, N. "Noble metal nanoparticle decorated tungsten diselenidenanosheets for ultrasensitive detection of NO_2 at room temperature", *Journal of Alloys and Compounds*, **899** (2022) 163166.

References

Salavagione, H. J. Díez-Pascual, A. M., Lázaro, E. Vera, S. and Gómez-Fatou, M. A. "Chemical sensors based on polymer composites with carbon nanotubes and graphene: the role of the polymer", *Journal of Materials Chemistry A*, **2(35)** (2014) 14289-14328.

Saraf, M. Natarajan, K. and Mobin, S. M. "Emerging robust heterostructure of MoS_2–rGO for high-performance supercapacitors", *ACS Applied Materials & Interfaces*, **10(19)** (2018) 16588-16595.

Sastry, C. S. Srinivas, K. R. and Prasad, K. M. "Spectrophotometric determination of drugs in pharmaceutical formulations with N-bromosuccinimide and celestine blue", *Microchimica Acta*, **122(1)** (1996) 77-86.

Savarino, A., Di Trani, L., Donatelli, I. Cauda, R. and Cassone, A. "New insights into the antiviral effects of chloroquine", *The Lancet Infectious Diseases*, **6(2)** (2006) 67-69.

Scozzari, A. "Electrochemical sensing methods: A brief review". *Algal Toxins: Nature, Occurrence, Effect and Detection*, (2008) 335-351.

Selvam, S. P. Chinnadayyala, S. R. and Cho, S. "Electrochemical nanobiosensor for early detection of rheumatoid arthritis biomarker: anti-cyclic citrullinated peptide antibodies based on polyaniline (PANI)/MoS_2-modified screen-printed electrode with PANI-Au nanomatrix-based signal amplification", *Sensors and Actuators B: Chemical*, **333** (2021) 129570.

Sha, R. and Bhattacharyya, T. K. "MoS_2-based nanosensors in biomedical and environmental monitoring applications", *Electrochimica Acta*, **349**, (2020) 136370.

Shafaati, A. and Clark, B. J. "Determination of azathioprine and its related substances by capillary zone electrophoresis and its application to pharmaceutical dosage forms assay", *Drug Development and Industrial Pharmacy*, **26(3)** (2000) 267-273.

Shahrokhian, S. and Ghalkhani, M. "Electrochemical study of Azathioprine at thin carbon nanoparticle composite film electrode", *Electrochemistry Communications*, **11(7)** (2009) 1425-1428.

References

Shahrokhian, S. and Ghalkhani, M. "Glassy carbon electrodes modified with a film of nanodiamond–graphite/chitosan: Application to the highly sensitive electrochemical determination of Azathioprine", *Electrochimica Acta,* **55(11)** (2010) 3621-3627.

Shin, H. J. Kim, K. K. Benayad, A. Yoon, S. M. Park, H. K. Jung, I. S. Jin, M. H. Jeong, H. K. Kim, J. M. Choi, J. Y. and Lee, Y. H. "Efficient reduction of graphite oxide by sodium borohydride and its effect on electrical conductance", *Advanced Functional Materials,* **19(12)** (2009) 1987-1992.

Simões, F. R. and Xavier, M. G. "Electrochemical Sensors", *Nanoscience and its Applications,* William Andrew, (2017) 155-178.

Singh, M. K. Pandey, R. K. and Prakash, R. "High-performance photo detector based on hydrothermally grown SnO_2 nanowire/reduced graphene oxide (rGO) hybrid material", *Organic Electronics,* **50** (2017) 359-366.

Singh, P. Ojha, R. P. Kumar, S. Singh, A. K. and Prakash, R. "Fe-doped MoS_2 nanomaterials with amplified peroxidase mimetic activity for the colorimetric detection of glutathione in human serum", *Materials Chemistry and Physics*, **267** (2021) 124684.

Skoog, D. A. Holler, F. J. and Crouch, S. R. "Instrumental Analysis, 6^{th}, Indian Reprint" (2010).

Solanki, S. Soni, A. Pandey, M. K. Biradar, A. and Sumana, G. "Langmuir-blodgettnano assemblies of MoS_2-Au composite at the air-water interface for dengue detection", *ACSApplied Materials & Interfaces,***10(3)** (2018) 3020–3028.

Sotelo, J. Briceño, E. and López-González, M. A. "Adding chloroquine to conventional treatment for glioblastoma multiforme: a randomized, double-blind, placebo-controlled trial", *Annals of Internal Medicine,* **144(5)** (2006) 337-343.

Srivastava, M. Nirala, N. R. Srivastava, S. K. and Prakash, R. "A comparative study of aptasensor vs immunosensor for label-free PSA cancer detection on GQDs-AuNRs modified screen-printed electrodes", *Scientific Reports,* **8(1)** (2018) 1-11.

Su, S. Sun, H. Cao, W. Chao, J. Peng, H. Zuo, X. Yuwen, L. Fan, C and Wang, L. "Dual-target electrochemical biosensing based on DNA structural switching on gold

nanoparticle-decorated MoS_2 nanosheets", *ACS Applied Materials & Interfaces,* **8(11)** (2016) 6826-6833.

Sun, H. Chao, J. Zuo, X. Su, S. Liu, X. Yuwen, L.Fan, C. and Wang, L. "Gold nanoparticle-decorated MoS_2nanosheets for simultaneous detection of ascorbic acid, dopamine and uric acid", *RSC Advances,* **4(52)**(2014) 27625-27629.

Sun, P. Zhang, W. Hu, X. Yuan, L. and Huang, Y. "Synthesis of Hierarchical MoS_2 and Its Electrochemical Performance as Anode Material for Lithium-Ion Batteries", *Journal of Materials Chemistry A,***2(10)**(2013)3498-3504.

Tajik, S. and Beitollahi, H. "A sensitive chlorpromazine voltammetric sensor based on graphene oxide modified glassy carbon electrode", *Analytical and Bioanalytical Chemistry Research,* **6(1)** (2019) 171-182.

Tang, H. Wang, J. Yin, H. Zhao, H. Wang, D. and Tang, Z. "Growth of polypyrrole ultrathin films on MoS_2 monolayers as high-performance supercapacitor electrodes. *Advanced Materials,* **27(6)** (2015) 1117-1123.

Thapliyal, N. B. Chiwunze, T. E. Karpoormath, R. and Cherukupalli, S. "Fabrication of highly sensitive gold nanourchins based electrochemical sensor for nanomolar determination of primaquine", *Materials Science and Engineering: C,* **74** (2017) 27–35.

Thapliyal, N. Chiwunze, T. E. Karpoormath, R. Goyal, R. N. Patel, H. and Cherukupalli, S. "Research progress in electroanalytical techniques for determination of antimalarial drugs in pharmaceutical and biological samples", *RSC Advances,* **6(62)** (2016) 57580-57602.

Titus, D. Samuel, E. J. J. and Roopan, S. M. "Nanoparticle characterization techniques. In Green synthesis, characterization and applications of nanoparticles", *Elsevier,* (2019) 303-319).

Tiwari, P. Kumar, A. and Prakash, R. "Electrochemical detection of azidothymidine on modified probes based on chitosan stabilised silver nanoparticles hybrid material", *RSC Advances,* **5(109)** (2015) 90089-90097.

References

Tiwari, P. Nirala, N. R. and Prakash, R. "Determination of the Anti-HIV Drug Nevirapine Using Electroactive 2D Material Pd@ rGO decorated with MoS_2 Quantum Dots", *Chemistry Select,* **3(19)**(2018) 5341-5347.

Thomas, C. F. and Limper, A. H. "Current insights into the biology and pathogenesis of Pneumocystis pneumonia", *Nature Reviews Microbiology,***5(4)** (2007) 298-308.

Thomas Jr, C. F. and Limper, A. H. "Pneumocystis pneumonia", *New England Journal of Medicine,* **350** (2004) 2487-2498

Tsuchiya, M. Torres, E. Aaron, J. J. and Winefordner, J. D. "Photochemical fluorimetric determination of primaquine in a flowing solvent with application to blood serum", *Analytical Letters,***17(16)** (1984) 1831-1841.

Tsutsumi, K. Otsuki, Y. and Kinoshita, T. "Simultaneous determination of azathioprine and 6-mercaptopurine in serum by reversed-phase high-performance liquid chromatography", *Journal of Chromatography B: Biomedical Sciences and Applications*, **231(2)** (1982) 393-399.

Ullah, A. Rauf, A. Rana, U. A. Qureshi, R. Ashiq, M. N. Hussain, H. Kraatz, H. B. Badshah, A. and Shah, A. "pH dependent electrochemistry of anthracenediones at a glassy carbon electrode", *Journal of The Electrochemical Society,***162(3)** (2015) H157-H163.

Upadhyay, R. K. Naskar, S. Bhaskar, N. Bose, S. and Basu, B. "Modulation of Protein Adsorption and Cell Proliferation on Polyethylene Immobilized Graphene Oxide Reinforced HDPE Bionanocomposites", *ACS Applied Materials & Interfaces,* **8(19)**(2016) 11954-11968.

Vais, R. D. Sattarahmady, N. Karimian, K. and Heli, H. "Green electrodeposition of gold hierarchical dendrites of pyramidal nanoparticles and determination of azathioprine", *Sensors and Actuators B: Chemical,* **215** (2015) 113-118.

Wang, J. Zhao, P. and Han, S. "Direct determination of azathioprine in human fluids and pharmaceutical formulation using flow injection chemiluminescence analysis", *Journal of the Chinese Chemical Society,* **59(2)** (2012) 239-244.

References

Wang, J. Zhao, Q. Hou, H. Wu, Y. Yu, W. Ji, X. and Shao, L. "Nickel nanoparticles supported on nitrogen-doped honeycomb-like carbon frameworks for effective methanol oxidation", *RSC Advances,* **7(23)** (2017) 14152-14158.

Wang, L. Chaia, Y. Rena, J. Dinga, J. Liu, Q. Dai, W. L. "Ag_3PO_4 nanoparticles loaded on 3D flower-like spherical MoS_2: Highly efficient hierarchical heterojunction photocatalyst", *Dalton Transactions,***44 (33)** (2013) 14625-14634.

Wang, Y. Zhang, B. Tang, Y. Zhao, F. and Zeng, B. "Fabrication and application of a rutin electrochemical sensor based on rose-like AuNPs-MoS_2-GN composite and molecularly imprinted chitosan", *Microchemical Journal,* **168** (2021) 106505.

Wang, Z. Hu, T. Liang, R. and Wei, M. "Application of zero-dimensional nanomaterials in biosensing", *Frontiers in Chemistry,* **8** (2020) 320.

Weingarten, H. L. and Cherry, E. J. "A chloroquine fatality", *Clinical Toxicology,* **18(8)** (1981) 959-963.

WHO, World Malaria Report 2018, Geneva, 2018. ISBN 978-92-4-156565-3

World Health Organization "Compendium of WHO malaria guidance: prevention, diagnosis, treatment, surveillance and elimination" (No. WHO/CDS/GMP/2019.03) (2019).

Worsfold, P. Townshend, A. Poole, C. F. and Miró, M. "Encyclopedia of analytical science", *Elsevier,* (2019).

Wu, S. Zeng, Z. He, Q. Wang, Z. Wang, S. J. Du, Y. Yin, Z. Sun, X. Chen, W. and Zhang, H. "Electrochemically reduced single-layer MoS_2 nanosheets: Characterization, properties, and sensing applications", *Small,* **8(14)** (2012) 2264-2270.

Wu, Z. Y. Liang, H. W. Chen, L. F. Hu, B. C. and Yu, S. H. "Bacterial cellulose: a robust platform for design of three dimensional carbon-based functional nanomaterials", *Accounts of Chemical Research,* **49(1)** (2016) 96-105.

Xing, L. and Ma, Z. "A glassy carbon electrode modified with a nanocomposite consisting of MoS_2 and reduced graphene oxide for electrochemical simultaneous

determination of ascorbic acid, dopamine, and uric acid", *Microchimica Acta*, **183(1)** (2016) 257-263.

Xing, Z. Ju, Z. Zhao, Y. Wan, J. Zhu, Y. Qiang, Y. and Qian, Y. "One-pot hydrothermal synthesis of Nitrogen-doped graphene as high-performance anode materials for lithium ion batteries", *Scientific reports*, **6(1)** (2016) 1-10.

Xiong, D. Li, X. Shan, H. Zhao, Y. Dong, L. Xu, H. Zhang, X. Li, D. and Sun, X. "Oxygen-containing functional groups enhancing electrochemical performance of porous reduced graphene oxide cathode in lithium ion batteries", *Electrochimica Acta*, **174** (2015) 762-769.

Xu, C. and Wang, X. "Fabrication of flexible metal-nanoparticle films using graphene oxide sheets as substrates", *Small*, **5(19)** (2009) 2212-2217.

Yan, X. Dai, Y. Chen, M. Wang, J. Ren, J. Wang, Q. Wu, Y. Ye, N. Wang, Y. and Cheng, X. "WS_2 nanosheets decorated by Ag nanoparticles with different content and uniform distribution for enhanced electrochemical properties", *Journal of Nanoparticle Research*, **19(5)** (2017) 1-9.

Yan, Y. Zhang, C. Gu, W. Ding, C. Li, X. and Xian, Y. "Facile synthesis of water-soluble WS_2 quantum dots for turn-on fluorescent measurement of lipoic acid", *The Journal of Physical Chemistry C*, **120(22)** (2016) 12170-12177.

Yang, T. Chen, H. Ge, T. Wang, J. Li, W. and Jiao, K. Highly sensitive determination of chloramphenicol based on thin-layered MoS_2/polyaniline nanocomposite", *Talanta*, **144** (2015) 1324-1328.

Yang, Y. Cui, J. Zheng, M. Hu, C. Tan, S. Xiao, Y. Yang, Q., and Liu, Y. "One-step synthesis of amino-functionalized fluorescent carbon nanoparticles by hydrothermal carbonization of chitosan", *Chemical Communications*, **48(3)** (2012) 380-382.

Yang, Z. C. Wang, M. Yong, A. M. Wong, S. Y. Zhang, X. H. Tan, H. Chang, A.Y. Li, X. and Wang, J. "Intrinsically fluorescent carbon dots with tunable emission derived from hydrothermal treatment of glucose in the presence of monopotassium phosphate", *Chemical communications*, **47(42)** (2011) 11615-11617.

References

Yin, S. Men, X. Sun, H. She, P. Zhang, W. Wu, C. Qin, W. and Chen, X. "Enhanced photocurrent generation of bio-inspired graphene/ZnO composite films", *Journal of Materials Chemistry A*, **3(22)** (2015) 12016-12022.

Yougbaré, S. Mutalik, C. Chung, P. F. Krisnawati, D. I. Rinawati, F. Irawan, H. Kristanto, H. and Kuo, T. R. "Gold nanorod-decorated metallic MoS_2 nanosheets for synergistic photothermal and photodynamic antibacterial therapy", *Nanomaterials*, **11(11)** (2021) 3064.

Yun, Q. Lu, Q. Zhang, X. Tan, C. and Zhang, H. "Three-dimensional architectures constructed from transition-metal dichalcogenide nanomaterials for electrochemical energy storage and conversion", *AngewandteChemie International Edition*, **57(3)** (2018) 626-646.

Zen, J. M. Jou, J. J. and Kumar, A. S. "A sensitive voltammetric method for the determination of parathion insecticide", *Analytica Chimica Acta*, **396(1)** (1999) 39-44.

Zeng, Y. Shen, Z. Wu, X. Wang, D. X. Wang, Y. L. Sun, Y. L., Wu, L. and Zhang, Y. "Back contact modification of the optoelectronic device with transition metal dichalcogenide VSe_2 film drives solar cell efficiency", *Journal of Materiomics*, **7(3)** (2021) 470-477.

Zhang, D. Wu, J. Li, P. and Cao, Y. "Room-temperature SO 2 gas-sensing properties based on a metal-doped MoS 2 nanoflower: An experimental and density functional theory investigation", *Journal of Materials Chemistry A*, **5(39)** (2017) 20666-20677.

Zhang, D. Yang, Z. Li, P. Pang, M. and Xue, Q. "Flexible self-powered high-performance ammonia sensor based on Au-decorated $MoSe_2$ nanoflowers driven by single layer MoS_2-flake piezoelectric nanogenerator", *Nano Energy*, **65** (2019) 103974.

Zhang, P. Lu, X. Huang, Y. Deng, J. Zhang, L. Ding, F. Su, Z. Wei, G. and Schmidt, O. G. "MoS_2 nanosheets decorated with gold nanoparticles for rechargeable Li–O2 batteries", *Journal of Materials Chemistry A*, **3(28)** (2015) 14562-14566.

Zhang, P. Zhang, X. Zhang, S. Lu, X. Li, Q. Su, Z. and Wei, G. "One-pot green synthesis, characterizations, and biosensor application of self-assembled reduced graphene oxide–

gold nanoparticle hybrid membranes", *Journal of Materials Chemistry B*, **1(47)** (2013) 6525-6531.

Zhang, X. Lai, Z. Tan, C. and Zhang, H. "Solution-Processed Two-Dimensional MoS_2 Nanosheets: Preparation, Hybridization, and Applications", *Angewandte Chemie International Edition*,**55(31)**(2016) 8816-8838.

Zhang, X. H. Tan, H. Fan, Z. Ge, M. Z. Ye, X. and Xue, M. Q. "SYNTHESIS AND ELECTROCHEMICAL PERFORMANCE OF ULTRATHIN WS_2 NANOSHEETS", *Chalcogenide Letters*, **14(10)** (2017) 419-423.

Zhao, L. Jia, J. Yang, Z. Yu, J. Wang, A. Sang, Y. Zhou, W. and Liu, H. "One-step synthesis of CdS nanoparticles/MoS_2 nanosheets heterostructure on porous molybdenum sheet for enhanced photocatalytic H_2 evolution", *Applied Catalysis B: Environmental*, **210** (2017) 290-296.

Zhao, X. He, D. Wang, Y. and Fu, C. "Facile fabrication of tungsten disulfide quantum dots (WS_2 QDs) as effective probes for fluorescence detection of dopamine (DA)", *Materials Chemistry and Physics*, **207** (2018) 130-134.

Zhao, X. Zhang, P. Chen, Y. Su, Z. and Wei, G. "Recent advances in the fabrication and structure-specific applications of graphene-based inorganic hybrid membranes", *Nanoscale*, **7(12)** (2015) 5080-5093.

Zhao, Y. Cai, Y. Zhang, L. Li, B. Zhang, G. and Thong, J. T. "Thermal transport in 2D semiconductors—considerations for device applications", *Advanced Functional Materials*, **30(8)** (2020) 1903929.

Zhou, X. Huang, X. Qi, X. Wu, S. Xue, C. Boey, F. Y. Yan, Q. Chen, P. and Zhang, H. "In situ synthesis of metal nanoparticles on single-layer graphene oxide and reduced graphene oxide surfaces", *The Journal of Physical Chemistry C*, **113(25)** (2009) 10842-10846.

Zhou, Y. Sui, C. Yin, H. Wang, Y. Wang, M. and Ai, S. "Tungsten disulfide (WS_2) nanosheet-based photoelectrochemicalaptasensing of chloramphenicol", *Microchimica Acta*, **185(10)** (2018) 1-8.

References

Zhu, S. Wang, J. and Fan, W. “Graphene-based catalysis for biomass conversion”, *Catalysis Science & Technology*, **5(8)** (2015) 3845-3858.

List of Publications

Research Publications:

1. **Vineet Kumar Mall,** Ravi Prakash Ojha, Preeti Tiwari, Rajiv Prakash, "Immunosuppressive drug sensor based on MoS_2-polycarboxyindole modified electrodes", *Results in Chemistry*, 4 (2022) 100345, DOI: 10.1016/j.rechem.2022.100345.

2. Monika Srivastava, Preeti Tiwari, **Vineet Kumar Mall**, Sanjay Kumar Srivastava, Rajiv Prakash, "Voltammetric determination of the antimalarial drug chloroquine using a glassy carbon electrode modified with reduced graphene oxide on WS_2 quantum dots", *Microchimica Acta*, 186(7) (2019) 1, DOI: 10.1007/s00604-019-3525-3.

3. **Vineet Kumar Mall**, Ravi Prakash Ojha, Priya Singh, Rajiv Prakash, "Gold nano rods decorated MoS_2 nanosheets modified electrodes for the voltammetric estimation of anti malarial drug" (Communicated).

4. **Vineet Kumar Mall**, Preeti Tiwari, Madhu Tiwari, Rajiv Prakash, "Synthesis of Poly (indole-5-carboxylic acid) using Microwave Irradiation" (Communicated).

5. **Vineet Kumar Mall**, Preeti Tiwari, Rajiv Prakash, "2D material modified electrode towards detection of anti-cancerous drug" (Communicated).

Symposium and Conferences

1. The 4^{th} International Conference on Advances in Materials and Materials Processing on 5^{th}-7^{th} Nov 2016 in IIT Kharagpur (Oral Presentation)

2. Global Initiative for Academic Networks (GIAN) Workshop on Nanochemistry: From Preorganised Molecular Architectures to Functional Materials on 19^{th}-23^{rd} Dec 2016 in IIT (BHU) Varanasi (Attended)

List of Publications

3. 20th CRSI National Symposium in Chemistry on 3rd-5th Feb 2017 in Gauhati University (Poster presentation)

4. National Conference on Energy, Environment and its Impact on Society (NCEEIS-2017) on 19th-20th Jan 2017 in K.N.Govt. P.G. College, Gyanpur, Bhadohi (Poster presentation)

5. Institute day of IIT (BHU) on 25th-26th Feb 2017 in IIT (BHU) Varanasi (Poster presentation)

6. 45th National Seminar on Crystallography (NSC 45) on 9th-12 July 2017 in IIT (BHU) Varanasi (Volunteered)

7. 4th International Conference on Nanoscience and Nanotechnolgy (ICONN 2017) on 9th-11th August 2017 in SRM University Chennai (Poster presentation)

Microchimica Acta (2019) 186:415
https://doi.org/10.1007/s00604-019-3525-3

ORIGINAL PAPER

Voltammetric determination of the antimalarial drug chloroquine using a glassy carbon electrode modified with reduced graphene oxide on WS_2 quantum dots

Monika Srivastava [1] · Preeti Tiwari [1] · Vineet Kumar Mall [1] · S. K. Srivastava [2] · Rajiv Prakash [1]

Received: 10 February 2019 / Accepted: 19 May 2019

Abstract

A voltammetric method is described for the determination of chloroquine (CQ) and validated simultaneously by two techniques and in three different conditions. The WS_2 quantum dots (WS_2 QDs) were synthesized by a hydrothermal method and then placed on reduced graphene oxide (rGO) sheets. The resulting composite material was then deposited on a glassy carbon electrode (GCE) where it showed excellent electroactivity. The modified GCE responds to chloroquine at a typical potential maximum of 1.2 V (*vs*. AgCl/Ag). Techniques including cyclic voltammetry and differential pulse voltammetry were tested. Features of merit include (a) a wide linear response (in the 0.5 μM to 82 μM CQ concentration range), (b) an electrochemical sensitivity of 0.143–0.90 $\mu A \cdot \mu M^{-1} \cdot cm^{-2}$), and a 40–120 nM limit of detection (at $S/N = 3$). The sensor has excellent selectivity even in the presence of potentially interfering biological compounds. Responses were tested in phosphate buffer, human serum and pharmaceutical formulations, and no cross reactivity or matrix effects were found. In all the three cases, quite satisfactory recoveries were obtained.

Keywords Chloroquine phosphate · Anti-malarial drug · Reduced graphene oxide · WS_2 quantum dots · Synergistic effect

Introduction

Chloroquine (CQ) is extensively used in the treatment of sudden attacks of malaria and elimination of porphylaxis for many decades. This drug is widely used for curing rheumatoid arthritis and similar kinds of collagen diseases. Chloroquine is also used for amoebic hepatitis treatment [1–3]. Various strains of *Plasmodium falciparum* have developed resistance against CQ [4]. But due to its low cost this drug is still widely used in developing countries. It is also recommended as a strong anti-cancerous agent [5, 6]. High doses of this drug may cause several side effects like heart attack [7]. There are various analytical methods reported in the literature to monitor the concentration of drug like spectrophotometric method [8], high performance liquid chromatography with fluorescence detection [9, 10], chemiluminescence including radiostorage- and photostorage-chemiluminescence(CL) [11] and voltammetric methods [12]. Among all methods voltammetric methods got immense attention due to its fast response, less volume consumption of samples, high selectivity and sensitivity.

Graphene is an atom-thick two dimensional crystalline carbon film with sp^2 hybrid carbon atoms. It reveals the unprecedented amalgamation of beneficial properties such as remarkable mechanical strength, large surface area, high thermal conductivity and extraordinary electrical properties like tremendous charge carrier mobility and conductivity [13, 14]. Due to these peculiar material properties, graphene have grabbed significant attention and proved their applicability in the fields of sensors [15, 16], catalysis [17], energy-storage [18], electronics [19] and optoelectronics [20]. The graphene oxide (GO) possesses various hydrophilic groups like hydroxyl carboxyl, and epoxy and

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00604-019-3525-3) contains supplementary material, which is available to authorized users.

✉ Monika Srivastava
monikabhu.srivastava@gmail.com

✉ Rajiv Prakash
rprakash.mst@iitbhu.ac.in

[1] School of Materials Science and Technology, Indian Institute of Technology, Banaras Hindu University, Varanasi 221005, India

[2] Department of Physics, Institute of Science, Banaras Hindu University, Varanasi 221005, India

Published online: 11 June 2019

Results in Chemistry 4 (2022) 100345

Contents lists available at ScienceDirect

Results in Chemistry

journal homepage: www.sciencedirect.com/journal/results-in-chemistry

Immunosuppressive drug sensor based on MoS_2-polycarboxyindole modified electrodes

Vineet Kumar Mall, Ravi Prakash Ojha, Preeti Tiwari, Rajiv Prakash *

School of Materials Science and Technology, Indian Institute of Technology (BHU), Varanasi 221005, India

ARTICLE INFO

Keywords:
Immunosuppressive
Poly(5-carboxyindole)
MoS_2 nanosheets
Electrocatalytic

ABSTRACT

Azathioprine (Azp) is the principal immunosuppressive drug used in organ transplantation autoimmune diseases by improving therapeutic management and suppressing the immune system. Any discrepancy of Azp in human blood may lead to some serious side effects that obligate its quantitative estimation. In this work, the molybdenum disulfide (MoS_2) nanosheets modified with poly(5-carboxyindole) (CPIn) is reported for quantitative estimation of Azp. The synthesis of MoS_2 nanosheets is reported through single-step one-pot hydrothermal reaction and exfoliation of sheets is obtained in an aqueous dispersion of 5-carboxyindole (5CIn) through probe ultra-sonication. The nanosheets are further utilized as a template for the growth of the poly(5-carboxyindole) to obtain CPIn stabilized MoS_2 nanosheets (MoS_2-CPIn). The synthesis of MoS_2-CPIn nanohybrid is further validated via different characterization techniques including FTIR, XRD, SEM, TEM, and XPS. MoS_2-CPIn with magnificent electrocatalytic property is further exploited for the electroanalytical sensing of Azp via Differential Pulse Voltammetry (DPV) in phosphate buffer solution at biological pH (pH = 7.4) as well as human blood serum at room temperature. The proposed sensor shows a linear dependence of current with Azp concentration. The developed sensor demonstrates an extensively wide linear range of 3.49–284.44 μM possessing a low limit of detection of 74.65 nM (S/N = 3). The developed sensor shows excellent stability, sensitivity, and good selectivity in physiological pH. The achieved analytical parameters of the proposed sensor for easy quantification of Azp are found to be comparable or better than the previously reported Azp sensors and it is proved to be an excellent contestant for the trace level estimation of Azp in human blood serum.

1. Introduction

Azathioprine (Azp) is associated with a chemical category of purine analogues named 6-[(1-methyl-4-nitroimidazole-5-yl) thio] purine. Azp is an immunosuppressant and antileukemic drug that finds contemporary applications in various disorders such as ulcerative colitis, rheumatoid arthritis, Crohn's disease, and pemphigus [1,2]. Mercaptopurine is the active form of Azp which acts by decreasing the reactions of T and B cells by inhibiting their proliferation [3]. The continued exposure of Azp for a long time may lead to the development of specific types of cancer like skin cancer, blood cancer, and lymphoma and with some serious side effects including hair loss, nausea, fatigue, and rash. In order to counter these issues, it is crucial to evolve an accurate and sensitive method for the routine and careful monitoring of Azp in clinical operations [4,5]. In past, various techniques have been applied, for instance, high performance liquid chromatography (HPLC) [6,7], UV–Visible spectrophotometry [8,9], ^{1}H NMR spectroscopy [10], chemiluminescence [11,12], ultra-performance liquid chromatography [13], high performance thin layer chromatography [14], flow injection analysis [11], surface-enhanced Raman spectroscopy [15], capillary zone electrophoresis [16], titrimetry [17] for the determination of Azp in human blood. Although all these techniques are accurate, some of them suffer from various demerits like low sensitivity and selectivity, expensive instrumentation, high cost, time-consuming operation, cumbersome extraction procedure with complex and tedious sample pretreatment that makes them inappropriate for regular analysis in many cases. Analytical and electrochemical measurement techniques play a critical role in biological recognitions, environmental monitoring, and drugs estimation in human body fluids as well as pharmaceutical formulations. The modern electrochemical methods have an important role in these fields because they have come up with sensational advantages like broad linear dynamic range, high sensitivity, and selectivity, simplicity, short analysis time, cost-effectiveness with real-time monitoring [18–20]. Cyclic Voltammetry (CV) [21] and Differential Pulse

* Corresponding author.
E-mail address: rprakash.mst@iitbhu.ac.in (R. Prakash).

https://doi.org/10.1016/j.rechem.2022.100345
Received 12 February 2022; Accepted 17 April 2022
Available online 20 April 2022