REFERENCES

Alaba P.A., Lee C.S., Abnisa F., Aroua M.K., Cognet P., Pérès Y., Daud W.M., "A review of recent progress on electrocatalysts toward efficient glycerol electrooxidation", *Reviews in Chemical Engineering,* 2020.

Allaedini G., Aminayi P., Tasirin S.M., "Methane decomposition for carbon nanotube production: Optimization of the reaction parameters using response surface methodology", *Chemical Engineering Research and Design,* 2016, v. 112, pp. 163-174.

Antolini E., "Catalysts for direct ethanol fuel cells," *Journal of Power Sources,* 2007, v. 170, pp.1-12.

Antolini E., Colmati F., Gonzalez E.R., "Effect of Ru addition on the structural characteristics and the electrochemicalactivity for ethanol oxidation of carbon supported Pt Sn alloy catalysts", *Electrochemistry Communications,* 2007, v. 9, pp.398-404.

Antolini E., Gonzalez E.R., "Alkaline direct alcohol fuel cells," Journal of Power Sources, 2010, v. 195(11), pp. 3431-50.

Arjona N., Armenta-Gonzalez A.J., Rivas S., Guerra-Balcazar M., Ledesma-Garcia J., Arriaga L.G., "A new type of high performance air-breathing glucose membraneless microfluidic fuel cell", *International Journal of Hydrogen Energy,* 2015, v. 40(42), pp. 14699-14705.

Armenta-González A.J., Carrera-Cerritos R., Moreno-Zuria A., Álvarez-Contreras L., Ledesma-García J., Cuevas-Muñiz F.M., Arriaga L.G., "An improved ethanol microfluidic fuel cell based on a PdAg/MWCNT catalyst synthesized by the reverse micelles method," *Fuel,* 2016, v.167, pp. 240-247.

Azad K., Rasul M.G., Khan M.M., Sharma S.C., "Introduction to sustainable and alternative ecofuels," *Advances in Eco-Fuels for a Sustainable Environment,* Woodhead Publishing, 2019, pp. 1-14.

Badwal S.P., Foger K., "Solid oxide electrolyte fuel cell review," *Ceramics International,* 1996, v. 22(3), pp. 257-65.

Bagmut A.G., Shipkova I.G., Zhuchkov V.A., "Formation, structure, and magnetic changes at annealing of films deposited by laser sputtering of Ni and Pd", *Journal of Surface Investigation. X-ray, Synchrotron and Neutron Techniques,* 2011, v. 5(3), pp. 460-464.

Bagotsky V.S., Fuel Cells: Problems and Solutions, *John Wiley & Sons,* 2012.

Banerjee R., Kumar S.J., Mehendale N., Sevda S., Garlapati V.K., "Intervention of microfluidics in biofuel and bioenergy sectors: Technological considerations and future prospects," *Renewable and Sustainable Energy Reviews,* 2019, v. 101, pp. 548-58.

Baranton S., Coutanceau C., "Nickel cobalt hydroxide nanoflakes as catalysts for the hydrogen evolution reaction," *Applied Catalysis B: Environmental,* 2013, v. 136, pp.1-8.

Barceloux D.G., Randall Bond G., Krenzelok E.P., Cooper H., Allister Vale., "American Academy of Clinical Toxicology practice guidelines on the treatment of methanol poisoning," *Journal of Toxicology: Clinical Toxicology,* 2002, v. 40(4), pp. 415-46.

Bard A.J., Faulkner L.R., Electrochemical Methods 2nd ed.,*Wiley: New York*, 2002.

Baş D., Boyacı I.H., "Modeling and optimization I: Usability of response surface methodology", *Journal of Food Engineering*, 2007, v. 78(3), pp. 836-845.

Basu D., Basu S., "Performance studies of Pd–Pt and Pt–Pd–Au catalyst for electro-oxidation of glucose in direct glucose fuel cell", *International Journal of Hydrogen Energy*, 2012, v. 37(5), pp. 4678-4684.

Basu S., Recent Trends in Fuel Cell Science and Technology, *Anamaya Publishers: New Delhi*, 2007.

Benipal N., Qi J., Liu Q., Li W., "Carbon nanotube supported PdAg nanoparticles for electrocatalytic oxidation of glycerol in anion exchange membrane fuel cells," *Applied Catalysis B: Environmental*, 2017, v. 210, pp. 121-30.

Bezerra M.A., Santelli R.E., Oliveira E.P., Villar L.S., Escaleira L.A., "Response surface methodology (RSM) as a tool for optimization in analytical chemistry", *Talanta*, 2008, v. 76(5), pp. 965-977.

Bhunia K., Khilari S., Pradhan D., "Monodispersed PtPdNi trimetallic nanoparticles-integrated reduced graphene oxide hybrid platform for direct alcohol fuel cell," *ACS Sustainable Chemistry & Engineering*, 2018, v. 6(6), pp. 7769-7778.

Bianchini C., Shen P.K., "Palladium-based electrocatalysts for alcohol oxidation in half cells and in direct alcohol fuel cells," *Chemical Reviews*, 2009, v. 109(9), pp. 4183-206.

Bing Y., Liu H., Zhang L., Ghosh D., Zhang J., "Nanostructured Pt-alloy electrocatalysts for PEM fuel cell oxygen reduction reaction", *Chemical Society Reviews*, 2010, v. 39(6), pp. 2184-202.

Bock C., Halvorsen H., MacDougall B., "Catalyst synthesis techniques in PEM Fuel Cell Electrocatalysts and Catalyst Layers", *Springer, London*, 2008, pp. 447-485.

Caglar A., Sahan T., Cogenli M.S., Yurtcan A.B., Aktas N., Kivrak H., "A novel Central Composite Design based response surface methodology optimization study for the synthesis of Pd/CNT direct formic acid fuel cell anode catalyst", *International Journal of Hydrogen Energy*, 2018, v. 43(24), pp. 11002-11011.

Carrette L., Friedrich K.A., Stimming U., "Fuel cells-fundamentals and applications," *Fuel Cells*, 2001, v.1, pp. 5-39.

Central Electricity Authority India (*CEA*), 2020.

Chang M.H., Chen F., Fang N.S., "Analysis of membraneless fuel cell using laminar flow in a Y-shaped microchannel" *Journal of Power Sources*, 2006, v. 159(2), pp. 810-816.

Chen C., Kang Y., Huo Z., Zhu Z., Huang W., Xin H.L., Snyder J.D., Li D., Herron J.A., Mavrikakis M., Chi M., "Highly crystalline multimetallic nanoframes with three-dimensional electrocatalytic surfaces," *Science*, 2014, v. 343(6177), pp. 1339-1343.

Chen S., Kucernak A., "Electrocatalysis under conditions of high mass transport rate: Oxygen reduction on single submicrometer-sized Pt particles supported on carbon", *The Journal of Physical Chemistry B*, 2004, v. 108(10), pp. 3262-3276.

Cho Y.H., Choi B., Cho Y.H., Park H.S., Sung Y.E., "Pd-based PdPt (19: 1)/C electrocatalyst as an electrode in PEM fuel cell", *Electrochemistry Communications*, 2007, v. 9(3), pp. 378-381.

Choban E.R., Markoski L.J., Wieckowski A., Kenis P.J., "Microfluidic fuel cell based on laminar flow," *Journal of Power Sources*, 2004, v. 128(1), pp. 54-60.

Choban E.R., Spendelow J.S., Gancs L., Wieckowski A., Kenis P.J.A., "Membraneless laminar flow-based micro fuel cells operating in alkaline, acidic, and acidic/alkaline media", *Electrochimica Acta*,2005, v. 50(27), pp. 5390-5398.

Choudhary A.K., Pramanik H., "Synthesis of low-cost HNO_3-functionalized acetylene black carbon supported Pt-Ru/C AB nano electrocatalysts for the application in direct ethanol fuel cell (DEFC)", *Korean Journal of Chemical Engineering*, 2019, v. 36(10), pp. 1688-1707.

Cohen J.L., Westly D.A., Pechenik A., Abruña H.D., "Fabrication and preliminary testing of a planar membraneless microchannel fuel cell," *Journal of Power Sources*, 2005, v. 139(1-2), pp. 96-105.

Da Silva R.G., Neto S.A., Kokoh K.B., De Andrade A.R., "Electroconversion of glycerol in alkaline medium: from generation of energy to formation of value-added products," *Journal of Power Sources*, 2017, v. 351, pp. 174-182.

Dector A., Cuevas-Muñiz F.M., Guerra-Balcázar M., Godínez L.A., Ledesma-García J., Arriaga L.G., "Glycerol oxidation in a microfluidic fuel cell using Pd/C and Pd/MWCNT anodes electrodes," *International Journal of Hydrogen Energy*, 2013a, v. 38(28), pp.12617-22.

Dector A., Esquivel J.P., González M.J., Guerra-Balcázar M., Ledesma-García J., Sabaté N., Arriaga L.G., "Formic acid microfluidic fuel cell evaluation in different oxidant conditions", *Electrochimica Acta*, 2013b, v. 92, pp. 31-35.

Deraz N.M., "The comparative jurisprudence of catalysts preparation methods: I. Precipitation and impregnation methods", *Journal of Industrial and Environmental Chemistry*, 2018, v. 2(1), pp. 19-21.

Desmaële D., Nguyen-Boisse T.T., Renaud L., Tingry S., "A novel ethanol/oxygen microfluidic fuel cell with enzymes immobilized onto cantilevered porous electrodes", *In Journal of Physics: Conference Series IOP Publishing*,2016, v. 773, pp. 012016-012020.

Diaz-Real J.A., Guerra-Balcázar M., Arjona N., Cuevas-Muñiz F., Arriaga L.G., Ledesma-García J., Advances in Microfluidics: New Applications in Biology, Energy, and Materials Sciences, *Intechopen*, 2016.

do Valle W.F., Junco G.G., Profeti D., Olivi P., Profeti L.P., "Glycerol electrocatalytic oxidation on Pt (1− 2x) RuxSnxOy/Ti electrodes prepared by the polymeric precursor method," *Chemical Physics Letters*, 2015, v. 640, pp. 31-35.

dos Santos R.G., Alencar A.C., "Biomass-derived syngas production via gasification process and its catalytic conversion into fuels by Fischer Tropsch synthesis: A review," *International Journal of Hydrogen Energy*, 2020, v. 45(36), pp. 18114-32.

Dutta A., Datta J., "Energy efficient role of Ni/NiO in PdNi nano catalyst used in alkaline DEFC", *Journal of Materials Chemistry A*, 2014, v. 2(9), pp. 3237-32350.

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

Eshghi A., Behbahani E.S., Kheirmand M., Ghaedi M., "Pd, Pd–Ni and Pd–Ni–Fe nanoparticles anchored on MnO2/Vulcan as efficient ethanol electro-oxidation anode catalysts", *International Journal of Hydrogen Energy*, 2019, v. 44(52), pp. 28194-28205.

Faro M.L., Minutoli M., Monforte G., Antonucci V., Aricò A.S., "Glycerol oxidation in solid oxide fuel cells based on a Ni-perovskite electrocatalyst," *Biomass & Bioenergy*, 2011 v. 35(3), pp. 1075-84.

Feali M.S., Fathipour M., "An air-breathing microfluidic fuel cell with a finny anode", *Russian Journal of Electrochemistry*, 2014, v. 50(2), pp. 162-169.

Ferrigno R., Stroock A.D., Clark T.D., Mayer M., Whitesides G.M., "Membraneless vanadium redox fuel cell using laminar flow," *Journal of the American Chemical Society*, 2002, v. 124(44), pp. 12930-12931.

Fiorini G.S., Chiu D.T., "Disposable microfluidic devices: fabrication, function, and application," *BioTechniques*, 2005, v.38, pp.429-446.

Galindo R., Dector A., Arriaga L.G., Gutiérrez S., Herrasti P., "Maghemite as a catalyst for glucose oxidation in a microfluidic fuel cell," *Journal of Electroanalytical Chemistry*, 2012, v. 671, pp. 38-43.

Garcia A.C, Ferreira E.B., de Barros V.V., Linares J.J., Tremiliosi-Filho G., "PtAg/MnOx/C as a promising electrocatalyst for glycerol electro-oxidation in alkaline medium," *Journal of Electroanalytical Chemistry*, 2017, v. 793, pp. 188-196.

Garcia, A.C., Paganin, V.A. and Ticianelli, E.A., 2008. CO tolerance of PdPt/C and PdPtRu/C anodes for PEMFC. Electrochimica Acta, 53(12), pp. 4309-4315.

Geraldes A.N., da Silva D.F., e Silva L.G., Spinace E.V., Neto A.O., dos Santos M.C., "Binary and ternary palladium based electrocatalysts for alkaline direct glycerol fuel cell", *Journal of Power Sources*, 2015, v. 293, pp. 823-830.

Gilliam R.J., Graydon J.W., Kirk D.W., Thorpe S.J., "A review of specific conductivities of potassium hydroxide solutions for various concentrations and temperatures", *International Journal of Hydrogen Energy*, 2007, v. 32(3), pp. 359-364.

Gomes J.F., Tremiliosi-Filho G., Spectroscopic studies of the glycerol electro-oxidation on polycrystalline Au and Pt surfaces in acidic and alkaline media," *Electrocatalysis*, 2011, v. 2(2), pp. 96-105.

González-Cobos J., Baranton S., Coutanceau C., "Development of bismuth-modified PtPd nanocatalysts for the electrochemical reforming of polyols into hydrogen and value-added chemicals," *ChemElectroChem*, 2016, v. 3(10), pp. 1694-1704.

Grace A.N., Pandian K., "Pt, Pt–Pd and Pt–Pd/Ru nanoparticles entrapped polyaniline electrodes–A potent electrocatalyst towards the oxidation of glycerol", *Electrochemistry communications*, 2006, v. 8(8), pp. 1340-1348.

Guerrero-Pérez M.O., Rosas J.M., Bedia J., Rodríguez-Mirasol J., Cordero T., "Recent inventions in glycerol transformations and processing," *Recent Patents on Chemical Engineering*, 2009, v. 2(1), pp. 11-21.

Guima K.E., Coelho P.H., Trindade M.A., Martins C.A., "3D-Printed glycerol microfluidic fuel cell," *Lab on a Chip*, 2020, v.20(12), pp. 2057-61.

Gupta G., Slanac D.A., Kumar P., Wiggins-Camacho J.D., Wang X., Swinnea S., More K.L., Dai S., Stevenson K.J, Johnston KP., "Highly stable and active Pt− Cu oxygen reduction electrocatalysts based on mesoporous graphitic carbon supports," *Chemistry of Materials*. 2009, v. 21(19), pp. 4515-4526.

Gupta U.K., Pramanik H., "A study on synthesis of chemical crosslinked polyvinyl alcohol-based alkaline membrane for the use in low-temperature alkaline direct ethanol fuel cell", *The Journal of Electrochemical Energy Conversion and Storage*, 2019, v. 16(4), pp. 041005-041016.

Habibi E., Razmi H., "Glycerol electrooxidation on Pd, Pt and Au nanoparticles supported on carbon ceramic electrode in alkaline media", *International Journal of Hydrogen Energy*, 2012, v. 37(22), pp. 16800-16809.

Hasegawa S., Shimotani K., Kishi K., Watanabe H., "Electricity generation from decomposition of hydrogen peroxide," *Electrochemical and Solid State Letters*, 2004, v. 8(2), pp. A119-A121.

Hayre R.O., Cha S.W.,, Colella W.G., Prinz F.B., Fuel Cell Fundamentals, *John Wiley & Sons,Inc., New York*, 2009.

Holade Y., Morais C., Arrii-Clacens S., Servat K., Napporn T.W., Kokoh K.B., "New preparation of PdNi/C and PdAg/C nanocatalysts for glycerol electrooxidation in alkaline medium", *Electrocatalysis*, 2013, 4v. (3), pp. 167-178.

Houache M.S., Hughes K., Ahmed A., Safari R., Liu H., Botton G.A., Baranova E.A., "Electrochemical valorization of glycerol on Ni-rich bimetallic NiPd nanoparticles: insight into product selectivity using in situ polarization modulation infrared-reflection absorption spectroscopy", *ACS Sustainable Chemistry & Engineering*, 2019, v. 7(17), pp. 14425-14434.

Houache M.S., Hughes K., Baranova E.A., "Study on catalyst selection for electrochemical valorization of glycerol," *Sustainable Energy & Fuels*, 2019, v. 3(8), pp. 1892-915.

Ilie A., Simoes M., Baranton S., Coutanceau C., Martemianov S., "Influence of operational parameters and of catalytic materials on electrical performance of Direct Glycerol Solid Alkaline Membrane Fuel Cells," *Journal of Power Sources*, 2011, v.196, pp. 4965-4971.

Jang H.S., Park D.S., "Microfabrication of microchannels for fuel cell plates", *Sensors*. 2010, v. 10(1), pp. 167-175.

Jayashree R.S., Egas D., Spendelow J.S., Natarajan D., Markoski L.J., Kenis P.J.A., "Air-Breathing Laminar Flow-Based Direct Methanol Fuel Cell with Alkaline Electrolyte," Electro-chem. Solid-State Lett, 2006, v. 9, pp.A252–A256.

Jayashree R.S., Gancs L., Choban E.R., Primak A., Natarajan D., Markoski L.J., Kenis P.J., "Air-breathing laminar flow-based microfluidic fuel cell," *Journal of the American Chemical Society*, 2005, v. 127(48), pp. 16758-16759.

Jazie A.A., Pramanik H., Sinha A.S., "Transesterification of peanut and rapeseed oils using waste of animal bone as cost effective catalyst," *Materials for Renewable and Sustainable Energy*, 2013, v. 2(2), pp.1-10.

Jin W., Du H., Zheng S., Xu H., Zhang Y., "Comparison of the oxygen reduction reaction between NaOH and KOH solutions on a Pt electrode: the electrolyte-dependent effect", *The Journal of Physical Chemistry B*, 2010, v. 114(19), pp. 6542-6548.

Jindal A., Basu S., Chauhan N., Ukai T., Kumar D.S., Samudhyatha K.T., "Application of electrospun CNx nanofibers as cathode in microfluidic fuel cell, "*Journal of Power Sources*, 2017, v. 342, pp. 165-74

Joo, J.B., Kim, Y.J., Kim, W., Kim, N.D., Kim, P., Kim, Y. and Yi, J., Methanol-tolerant PdPt/C alloy catalyst for oxygen electro-reduction reaction. *Korean Journal of Chemical Engineering*, 2008, v. 25(4), pp.770-774.

June M., "The Potential Hazards of Human Activity around the Nuclear Plant Site: Case Study of Nuclear Plant Site at Indonesia," *Journal of Applied Science*, 2019, v. 5(7), pp.1-6.

Kahveci E.E., Taymaz I., "Experimental investigation on water and heat management in a PEM fuel cell using response surface methodology", *International Journal of Hydrogen Energy*, 2014, v. 39(20), pp. 10655-10663.

Kahyaoglu A, Benden B, Lamy C., "Electrocatalitic oxidation of glycerol on gold and platinum electrodes in aqueous medium", *Electrochimica Acta*, 1984, v. 29, pp. 1489-1492.

Khan M., Yousaf A.B., Chen M., Wei C., Wu X., Huang N., Qi Z., Li L., "Mixed-phase Pd–Pt bimetallic alloy on graphene oxide with high activity for electrocatalytic applications", *Journal of Power Sources*, 2015, v. 282, pp. 520-528.

Kim J.S., Yu J.K., Lee H.S., Kim J.Y., Kim Y.C., Han J.H., Oh I.H., Rhee Y.W., "Effect of temperature, oxidant and catalyst loading on the performance of direct formic acid fuel cell" *Korean Journal of Chemical Engineering*, 2005, v. 22(5), pp. 661-665.

Kim Y., Kim H., Kim W.B., "PtAg nanotubes for electrooxidation of ethylene glycol and glycerol in alkaline media," *Electrochemistry communications*, 2014, v. 46, pp. 36-39.

Kjeang E., Microfluidic Fuel Cells and Batteries, *Cham Heidelberg New York Dordrecht London: Springer International Publishing*, 2014.

Kjeang E., Djilali N., Sinton D., "Microfluidic fuel cells: A review," *Journal of Power Sources*, 2009, v.186, pp. 353-369.

Kjeang E., McKechnie J., Sinton D., Djilali N., "Planar and three-dimensional microfluidic fuel cell architectures based on graphite rod electrodes", *Journal of Power Sources*, 2007, v. 168(2), pp. 379-390.

Kjeang E., Michel R., Harrington D.A., Sinton D., Djilali N., "An alkaline microfluidic fuel cell based on formate and hypochlorite bleach," *Electrochimica Acta*, 2008, v. 54(2), pp. 698-705.

Kwon Y., Koper M.T.M., "Combining voltammetry with HPLC to electro-oxidation of glycerol", *Analytical Chemistry*, 2010, v. 82, pp. 5420-5424.

Larminie J., Dicks A., Fuel cell systems explained, 2003, Chichester, UK, *J. Wiley*.

Lee S., Kim H.J., Choi S.M., Seo M.H., Kim W.B., "The promotional effect of Ni on bimetallic PtNi/C catalysts for glycerol electrooxidation", *Applied Catalysis A: General*, 2012, v. 429, pp. 39-47.

Lee Y.W., Cha S., Park K.W., Sohn J.I., Kim J.M., "High performance electrocatalysts based on Pt nanoarchitecture for fuel cell applications", *Journal of Nanomaterials*, 2015, v. 2015.

Leger J.M., Coutanceau, C., Lamy C., 'Electrocatalysis for the direct alcohol fuel cell," *Wiley-VCH: Weinhei*, 2009, pp. 337-367.

Leong K.Y., See S., Lim J.W., Bashir M.J., Ng C.A., Tham L., "Effect of process variables interaction on simultaneous adsorption of phenol and 4-chlorophenol: statistical modeling and optimization using RSM", *Applied Water Science*, 2017, v. 7(4), pp. 2009-2020.

Li A., Chan S.H., Nguyen N.T., "A laser-micromachined polymeric membraneless fuel cell," *Journal of Micromechanics and Microengineering*, 2007, v. 17(6), pp. 1107-1113.

Li H., Sun G., Li N., Sun S., Su D., Xin Q., "Design and preparation of highly active Pt− Pd/C catalyst for the oxygen reduction reaction", *The Journal of Physical Chemistry C*, 2007, v. 111(15), pp. 5605-5617.

Li H., Xin Q., Li W., Zhou Z., Jiang L., Yang S., Sun G., "An improved palladium-based DMFCs cathode catalyst", *Chemical communications*, 2004, v. (23), pp. 2776-2777.

Li N., Xia W.Y., Xu C.W., Chen S., "Pt/C and Pd/C catalysts promoted by Au for glycerol and CO electrooxidation in alkaline medium", *Journal of the Energy Institute*, 2017, v. 90(5) , pp. 725-733.

Lim B., Jiang M., Camargo P.H., Cho E.C., Tao J., Lu X., Zhu Y., Xia Y., "Pd-Pt bimetallic nanodendrites with high activity for oxygen reduction," *Science*, 2009, v. 324(5932), pp. 1302-1305.

Liu C., Liu H., Liu L., "Potassium Permanganate as an Oxidant for a Microfluidic Direct Formate Fuel Cell", *International Journal of Electrochemical Science*, 2019, v. 14, pp. 4557-4570.

Lopes T., Antolini E., Gonzalez E.R., "Carbon supported Pt–Pd alloy as an ethanol tolerant oxygen reduction electrocatalyst for direct ethanol fuel cells", *International Journal of Hydrogen Energy*, 2008, v. 33(20), pp. 5563-5570.

López–Coronel A., Ortiz–Ortega E., Torres–Pacheco L.J, Guerra–Balcázar M., Arriaga L.G., Álvarez–Contreras L., Arjona N., "High performance of Pd and PdAg with well–defined facets in direct ethylene glycol microfluidic fuel cells", *Electrochimica Acta*, 2019, v. 320, pp. 134622-13435.

Ma L., Chu D., Chen R., "Comparison of ethanol electro-oxidation on Pt/C and Pd/C catalysts in alkaline media," *International Journal of Hydrogen Energy*, 2012, v. 37(15), pp. 11185-11194.

Maghsodi A., Hoseini M.M., Mobarakeh M.D., Kheirmand M., Samiee L., Shoghi F., Kameli M., "Exploration of bimetallic Pt-Pd/C nanoparticles as an electrocatalyst for oxygen reduction reaction", *Applied Surface Science*, 2011, v. 257(15), pp. 6353-6357.

Mäkelä M., "Experimental design and response surface methodology in energy applications: A tutorial review", *Energy Conversion and Management*, 2017, v. 151, pp. 630-640.

Mani P., Srivastava R., Strasser P., "Dealloyed Pt− Cu core− shell nanoparticle electrocatalysts for use in PEM fuel cell cathodes," *The Journal of Physical Chemistry C*, 2008, v. 112(7), pp. 2770-2778.

Martins C.A, Ibrahim O.A, Pei P., Kjeang E., "Towards a fuel-flexible direct alcohol microfluidic fuel cell with flow-through porous electrodes: Assessment of methanol, ethylene glycol and glycerol fuels*," Electrochimica Acta*, 2018a, v. 271, pp. 537-543.

Martins C.A., Ibrahim O.A., Pei P., Kjeang E., " "Bleaching" glycerol in a microfluidic fuel cell to produce high power density at minimal cost," *Chemical Communications*, 2018b, v. 54(2), pp. 192-195.

Martins C.A., Ibrahim O.A., Pei P., Kjeang E., "In situ decoration of metallic catalysts in flow-through electrodes: Application of Fe/Pt/C for glycerol oxidation in a microfluidic fuel cell," *Electrochimica. Acta*, 2019, v. *305*, pp. 47–55.

Maya-Cornejo J., Guerra-Balcázar M., Arjona N., Álvarez-Contreras L., Valadez F.J., Gurrola M.P., Ledesma-García J., Arriaga L.G., "Electrooxidation of crude glycerol as waste from biodiesel in a nanofluidic fuel cell using Cu@ Pd/C and Cu@ Pt/C," *Fuel*, 2016, v. 183, pp. 195-205.

Maya-Cornejo J., Ortiz-Ortega E., Álvarez-Contreras L., Arjona N., Guerra-Balcázar M., Ledesma-García J., Arriaga L.G., "Copper–palladium core–shell as an anode in a multi-fuel membraneless nanofluidic fuel cell: toward a new era of small energy conversion devices", *Chemical Communications*, 2015, v. 51(13), pp. 2536-2539.

Mellawati J., "The Potential Hazards of Human Activity around the Nuclear Plant Site: Case Study of Nuclear Plant Site at Indonesia," *Journal of Applied Science*, 2019, v. 5(7). pp. 1-6.

Mitrovski S.M., Elliott L.C., Nuzzo R.G., "Microfluidic devices for energy conversion: Planar integration and performance of a passive, fully immersed H2− O2 fuel cell," *Langmuir*, 2004, v. 20(17), pp. 6974-6976.

Moreno-Zuria A., Dector A., Arjona N., Guerra-Balcázar M., Ledesma-García J., Esquivel J.P., Sabaté N., Arriaga L.G., Chávez-Ramírez A.U., "Formic acid microfluidic fuel cell based on well-defined Pd nanocubes", *In Journal of Physics: Conference Series*, 2013, v. 476, pp. 012033-012038.

Moreno-Zuria A., Dector A., Cuevas-Muñiz F.M., Esquivel J.P., Sabaté N., Ledesma-García J., Arriaga L.G., Chávez-Ramírez A.U., "Direct formic acid microfluidic fuel cell design and performance evolution," *Journal of power source,* 2014, v. 269, pp. 783-788.

Morozan A., Jousselme B., Palacin S., "Low-platinum and platinum-free catalysts for the oxygen reduction reaction at fuel cell cathodes", *Energy & Environmental Science*, 2011 v. 4(4), pp. 1238-1254.

Mougenot M., Caillard A., Simoes M., Baranton S., Coutanceau C., Brault P., "PdAu/C catalysts prepared by plasma sputtering for the electro-oxidation of glycerol," *Applied Catalysis B: Environmental*. 2011, v. 107(3-4), pp. 372-379.

Myers RH., Montgomery D.C., Anderson-Cook C.M., "Response Surface Methodology: Process and Product Optimization Using Designed Experiments", *John Wiley & Sons*,2016.

Nascimento A.P., Linares J.J., "Performance of a direct glycerol fuel cell using KOH doped polybenzimidazole as electrolyte," *Journal of the Brazilian Chemical Society*. 2014, v. 25(3), pp. 509-516.

Nishanth K.G., Sridhar P., Pitchumani S., Shukla A.K., "A DMFC with methanol-tolerant-carbon supported-Pt-Pd-alloy cathode", *Journal of The Electrochemical Society*, 2011, v. 158(8), pp. B871-B876.

Nores-Pondal F.J., Vilella I.M., Troiani H., Granada M., de Miguel S.R., Scelza O.A., Corti H.R., "Catalytic activity vs. size correlation in platinum catalysts of PEM fuel cells prepared on carbon black by different methods", *International Journal of Hydrogen Energy*, 2009, v. 34(19), pp. 8193-8203.

Norskov J.K., Rossmeisl J., Logadottir A., Lindqvist L.R., Kitchin J.R., Bligaard T., Jonsson H., "Origin of the overpotential for oxygen reduction at a fuel-cell cathode", *The Journal of Physical Chemistry B,* 2004, v. 108(46), pp. 17886-17892.

Okur O., Karadağ Ç.İ., San F.G.B., Okumuş E., Behmenyar G., "Optimization of parameters for hot-pressing manufacture of membrane electrode assembly for PEM (polymer electrolyte membrane fuel cells) fuel cell", *Energy*, 2013, v. 57, pp. 574-580.

Oliveira V.L., Morais C., Servat K., Napporn T.W., Tremiliosi-Filho G., Kokoh K.B., "Studies of the reaction products resulted from glycerol electrooxidation on Ni-based materials in alkaline medium", *Electrochimica Acta*, 2014, v. 117, pp. 255-262.

Ong B.C., Kamarudin S.K., Basri S., "Direct liquid fuel cells: A review," *International Journal of Hydrogen Energy*, 2017, v. 42(15), pp. 10142-10157.

Ottoni C.A., da Silva S.G., De Souza R.F., Neto A.O., "Glycerol oxidation reaction using PdAu/C electrocatalysts", *Ionics*, 2016, v. 22(7), pp. 1167-75.

Ottoni C.A., Ramos C.D., De Souza R.F., Da Silva S.G., Spinace E.V., Neto A.O., "Glycerol and ethanol oxidation in alkaline medium using PtCu/C electrocatalysts," *International Journal of Electrochemical Science*, 2018, v.13, pp.1893-1904.

Pagano M., and Piegari L., "Electrical networks fed by fuel-cells for uninterruptible electrical supply," *In Industrial Electronics, 2002. ISIE 2002. Proceedings of the 2002 IEEE International Symposium on*, 2002, v. 3, pp. 953-958.

Panjiara D., Pramanik H., "Electrooxidation study of glycerol on synthesized anode electrocatalysts Pd/C and Pd-Pt/C in a Y-shaped membraneless air-breathing microfluidic fuel cell for power generation," *Ionics*, 2020a, v. 26, pp. 2435-2482.

Panjiara D., Pramanik H., "Optimization of Process Parameters Using Response Surface Methodology for Power Generation via Electrooxidation of Glycerol in T-Shaped Air Breathing Microfluidic Fuel Cell", *International Journal of Hydrogen Energy*,2020b, v. 45, pp. 33968-33979.

Panjiara D., Pramanik H., "Study the Effect of Calcium Hypochlorite and Air as Mixed Oxidant for Electrooxidation of Glycerol in an Air-Breathing Microfluidic Fuel Cell Using Synthesized low cost Pd-Ni/C Anode Electrocatalyst", *Canadian journal of Chemical Engineering*, 2021a, pp. 1-18 (https://doi.org/10.1002/cjce.24107).

Panjiara D., Pramanik H., "Synthesis of Pd and Pt Based Low Cost Bimetallic Anode Electrocatalyst for Glycerol Electrooxidation in Membraneless Air Breathing Microfluidic Fuel Cell", *Journal of Electrochemical Science and Technology*, 2021b, v. 12(1), pp. 38-57.

Peng Z., Yang H., "Designer platinum nanoparticles: Control of shape, composition in alloy, nanostructure and electrocatalytic property", *Nano today*, 2009, v. 4(2), pp. 143-164.

Perry R.H., Green D.W., Perry's Chemical Engineers' Handbook, *McGraw-Hill, New York*, 1999.

Pramanik H., Rathoure A.K., "Electrooxidation study of $NaBH_4$ in a membraneless microfluidic fuel cell with air breathing cathode for portable power application," *International Journal of Hydrogen Energy*, 2017, v. 42(8), pp. 5340-5350.

Prasanna D., Selvaraj V., "Development of non-covalent ternary polymer–CNT composites as a novel supporting material for electrooxidation of glycerol," *RSC advances*, 2015, v. 5(120), pp. 98822-98833.

Qian Y.., Wen W., Adcock P.A., Jiang Z., Hakim N., Saha M.S., Mukerjee S., "PtM/C catalyst prepared using reverse micelle method for oxygen reduction reaction in PEM fuel cells", *The Journal of Physical Chemistry C*, 2008, v. 112(4), pp. 1146-1157.

Ramaswamy N., Mukerjee S., "Fundamental mechanistic understanding of electrocatalysis of oxygen reduction on Pt and non-Pt surfaces: acid versus alkaline media*", Advances in Physical Chemistry*. 2012, v. 2012.

Rathoure A.K,, Pramanik H., "Electrooxidation study of methanol using H_2O_2 and air as mixed oxidant at cathode in air breathing microfluidic fuel cell," *International Journal of Hydrogen Energy* , 2016, v.41(34), pp. 15287-94.

Renaud L., Selloum D., Tingry S., "Xurography for 2D and multi-level glucose/O_2 microfluidic biofuel cell", *Microfluidics and Nanofluidics*, 2015, v. 18, pp. 1407-1416.

Rezaei B., Saeidi-Boroujeni S., Havakeshian E., Ensafi A.A., "Highly efficient electrocatalytic oxidation of glycerol by Pt-Pd/Cu trimetallic nanostructure electrocatalyst supported on nanoporous stainless steel electrode using galvanic replacement", *Electrochimica Acta*, 2016, v. 203, pp.41-50.

Roquet L., Belgsir E.M., Léger J.M., Lamy C., "Kinetics and mechanisms of the electrocatalytic oxidation of glycerol as investigated by chromatographic analysis of the reaction products: Potential and pH effects," *Electrochimica Acta*, 1994, v.39(16), pp.2387-94.

Salloum K.S., Hayes J.R., Friesen C.A., PosnerJ.D., Sequential flow membraneless microfluidic fuel cell with porous electrodes, *Journal of Power Sources*, 2008, v. 180, pp. 243–252.

San F.G.B., Okur O., Karadağ Ç.İ., Isik-Gulsac I., Okumuş E., "Evaluation of operating conditions on DBFC (direct borohydride fuel cell) performance with PtRu anode catalyst by response surface method", *Energy*, 2014, v. 71, pp. 160-169.

Sandford C., Edwards M.A., Klunder K.J., Hickey D.P., Li M., Barman K., Sigman M.S., White H.S., Minteer S.D., "A synthetic chemist's guide to electroanalytical tools for studying reaction mechanisms", *Chemical science*, 2019, v. 10(26), pp. 6404-6422.

Sandrini R.M., Sempionatto J.R., Herrero E., Feliu J.M., Souza-Garcia J., Angelucci C.A., "Mechanistic aspects of glycerol electrooxidation on Pt (111) electrode in alkaline media", *Electrochemistry Communications*, 2018, v. 86, pp. 149-152.

Schell M., Xu Y., Zdraveski Z., "Mechanism for the electrocatalyzed oxidation of glycerol deduced from an analysis of chemical instabilities," *The Journal of Physical Chemistry*, 1996, v.100(49), pp.18962-18969.

Scotti, G., "Micro fuel cell fabrication technologies", *PhD Thesis*, Aalto University, Espoo, Finland, 2014.

Shaegh S.A., Nguyen N.T., Chan S.H.m "Air-breathing microfluidic fuel cell with fuel reservoir", *Journal of Power Sources*, 2012, v. 209, pp. 312-317.

Shaegh S.S.M., Nguyen N.T., Chan S.H., "A review on membraneless laminar flow-based fuel cells," *International Journal of Hydrogen Energy*, 2011, v.36, pp. 5675–5694.

Simões M., Baranton S., Coutanceau C., "Electro-oxidation of glycerol at Pd based nano-catalysts for an application in alkaline fuel cells for chemicals and energy cogeneration," *Applied Catalysis B: Environmental*, 2010, v. 93(3-4), pp. 354-62.

Simões M., Baranton S., Coutanceau C., "Enhancement of catalytic properties for glycerol electrooxidation on Pt and Pd nanoparticles induced by Bi surface modification," *Applied Catalysis B: Environmental*, 2011, v.110, pp. 40-49.

Simoes M., Baranton S., Coutenceau C., "Electro-oxidation of glycerol at Pd based nano-catalysts for an application in alkaline fuel cells for chemicals and energy cogeneration," *Applied Catalysis B: Environmental*, 2010, v. 93, pp. 354-362.

Stamenković V., Schmidt T.J., Ross P.N., Marković N.M., "Surface composition effects in electrocatalysis: Kinetics of oxygen reduction on well-defined Pt3Ni and Pt3Co alloy surfaces," *The Journal of Physical Chemistry B*, 2002, v. 106(46), pp.11970-11979.

Stamenkovic V.R., Fowler B., Mun B.S., Wang G., Ross P.N., Lucas C.A., Marković N.M., "Improved oxygen reduction activity on Pt3Ni (111) via increased surface site availability," *Science*, 2007, v. 315(5811), pp. 493-497.

Su L., Jia W., Schempf A., Lei Y., "Palladium/titanium dioxide nanofibers for glycerol electrooxidation in alkaline medium," *Electrochemistry Communications*, 2009, v. 11(11), pp. 2199-2202.

Sudirman S., Adi W.A., Budianto E., Yudianti R., "Mono-Dispersed Pt/MWNTs: Growing Directly on Multiwall Carbon Nanotubes (MWNTs) Using NaBH4 as Reducing Agent for Component of Proton Exchange Membrane Fuel Cell (PEMFC)", *International Journal of Chemistry*, 2020, v. 12(1), pp. 37-48.

Tanveer M., Kim K.Y., "Effects of geometric configuration of the channel and electrodes on the performance of a membraneless micro-fuel cell", *Energy Conversion and Management*, 2017, v. 136, pp. 372-81.

Tayal J., Rawat B., Basu S., "Bi-metallic and tri-metallic Pt–Sn/C, Pt–Ir/C, Pt–Ir–Sn/C catalysts for electro-oxidation of ethanol in direct ethanol fuel cell", *International Journal of Hydrogen Energy*. 2011, v. 36(22), pp. 14884-14897.

Tayal J., Rawat B., Basu S., "Effect of addition of rhenium to Pt-based anode catalysts in electro-oxidation of ethanol in direct ethanol PEM fuel cell", *International Journal of Hydrogen Energy*, 2012, v. 37(5), pp. 4597-4605.

Togo M., Takamura A., Asai T., Kaji H., Nishizawa M., "An enzyme-based microfluidic biofuel cell using vitamin K3-mediated glucose oxidation, *Electrochimica Acta*, 2007, v. 52(14), pp. 4669-4674.

Van der Vliet D., Wang C., Debe M., Atanasoski R., Markovic N.M., Stamenkovic V.R., "Platinum-alloy nanostructured thin film catalysts for the oxygen reduction reaction", *Electrochimica Acta*, 2011, v. 56(24), pp. 8695-8699.

Vassilev S.V., Vassileva C.G., Vassilev V.S., "Advantages and disadvantages of composition and properties of biomass in comparison with coal: An overview," *Fuel*, 2015, v. 158, pp. 330-50.

Wang C., Markovic N.M., Stamenkovic V.R., "Advanced platinum alloy electrocatalysts for the oxygen reduction reaction", *ACS Catalysis*, 2012, v. 2(5), pp. 891-898.

Wang Y., Balbuena P.B., "Ab initio molecular dynamics simulations of the oxygen reduction reaction on a Pt (111) surface in the presence of hydrated hydronium $(H_3O)+(H_2O)_2$: direct or series pathway?," *The Journal of Physical Chemistry B*. 2005, v.109(31), pp. 14896-14907.

Wang H.N., Zhu X., Zhang B., Ye D.D., Chen R., Liao Q., Sui P.C., Djilali N., "Two-phase computational modelling of a membraneless microfluidic fuel cell with a flow-through porous anode", *Journal of Power Sources*, 2019, v. 420, pp. 88-98.

Wang Y., Li L., Hu L., Zhuang L., Lu J., Xu B., "A feasibility analysis for alkaline membrane direct methanol fuel cell: Thermodynamic disadvantages versus kinetic advantages," *Electrochemistry Communications*, 2003, v. 5, pp. 662–666.

Wang Z., Xin L., Zhao X., Qiu Y., Zhang Z., Baturina O.A., Li W., "Carbon supported Ag nanoparticles with different particle size as cathode catalysts for anion exchange membrane direct glycerol fuel cells," *Renewable Energy*, 2014, v. 62, pp. 556-62.

Yahya N., Kamarudin S.K., Karim N.A., Masdar M.S., Loh K.S., "Enhanced performance of a novel anodic PdAu/VGCNF catalyst for electro-oxidation in a glycerol fuel cell", *Nanoscale Research Letters*, 2017, v. 12(1), pp. 1-11.

Yan W.Y., Zheng S.L., Jin W., Peng Z., Wang S.N., Du H., Zhang Y., "The influence of KOH concentration, oxygen partial pressure and temperature on the oxygen reduction reaction at Pt electrodes", *Journal of Electroanalytical Chemistry*, 2015, v. 741, pp. 100-108.

Yan X., Xu A., Zeng L., Gao P., Zhao T., "A paper-based microfluidic fuel cell with hydrogen peroxide as fuel and oxidant," *Energy Technology*, 2018, v. 6(1), pp. 140-3.

Yildiz G., Kadirgan F., "Synergistic effect in the electrocatalytic oxidation of glycerol on platinumpalladium alloy electrodes", *Annales de Chimie*, 1994, v. 84, pp. 455-465.

Zalineeva A., Serov A., Padilla M., Martinez U., Artyushkova K., Baranton S., Coutanceau C., Atanassov P.B., "Glycerol electrooxidation on self-supported Pd1Snx nanoparticules", *Applied Catalysis B: Environmental*, 2015, v. 176, pp. 429-435.

Zhai C., Hu J., Gao H., Zeng L., Xue M., Liu Z.Q., Zhu M., "Nano-engineered hexagonal PtCuCo nanocrystals with enhanced catalytic activity for ethylene glycol and glycerol electrooxidation," *Journal of the Taiwan Institute of Chemical Engineers*, 2018, v. 93, pp. 477-84.

Zhang J., Sasaki K., Sutter E., Adzic R.R., "Stabilization of platinum oxygen-reduction electrocatalysts using gold clusters," *Science*, 2007, v. 315(5809), pp. 220-222.

Zhang Z., Xin L., Li W., "Electrocatalytic oxidation of glycerol on Pt/C in anion-exchange membrane fuel cell: Cogeneration of electricity and valuable chemicals." *Applied Catalysis B: Environmental,* 2012, v. *119*, pp.40–48.

Zhang Z., Xin L., Li W., "Supported gold nanoparticles as anode catalyst for anion-exchange membrane-direct glycerol fuel cell (AEM-DGFC)", *International Journal of Hydrogen Energy*, 2012, v. 37(11), pp. 9393-9401.

Zhang Z., Xin L., Qi J., Chadderdon D.J., Sun K., Warsko K.M., Li W., "Selective electro-oxidation of glycerol to tartronate or mesoxalate on Au nanoparticle catalyst via electrode potential tuning in anion-exchange membrane electro-catalytic flow reactor," *Applied Catalysis B: Environmental*, 2014, v. 147, pp. 871-878.

Zhiani M., Rostami H., Majidi S., Karami K., "Bis (dibenzylidene acetone) palladium (0) catalyst for glycerol oxidation in half cell and in alkaline direct glycerol fuel cel", *International Journal of Hydrogen Energy*, 2013, v. 38(13), pp. 5435-5441.

Zhou Y., Shen Y., Piao J., "Sustainable Conversion of Glycerol into Value-Added Chemicals by Selective Electro-Oxidation on Pt-Based Catalysts," *ChemElectroChem*, 2018, v. 5(13), pp. 1636-1643.

Zhou Y., Zhang B., Zhu X., Ye D.D., Chen R., Zhang T., Gong X.L., Liao Q., "Enhancing fuel transport in air-breathing microfluidic fuel cells by immersed fuel micro-jet", *Journal of Power Sources*, 2020, v. 445, pp. 227326-22734.

Zhu F., Kim J., Tsao K.C., Zhang J., Yang H., "Recent development in the preparation of nanoparticles as fuel cell catalysts", *Current Opinion in Chemical Engineering*, 2015, v. 8, pp. 89-97.

Zhu X., Cho H.R., Pasupong M., Regalbuto J.R., "Charge-enhanced dry impregnation: A simple way to improve the preparation of supported metal catalysts", ACS Catalysis, 2013, v. 3(4), pp. 625-630.

Zou H., Chen J., Fang Y., Ding J., Peng W., Liu R., "A dual-electrolyte based air-breathing regenerative microfluidic fuel cell with 1.76 V open-circuit-voltage and 0.74 V water-splitting voltage", *Nano Energy*, 2016, v. 27, pp. 619-626.

Appendix A

Figure A1 Photographic view of the air breathing Y-shaped MFC experimental setup.

Figure A2 Photographic view of the air breathing T-shaped MFC experimental setup.

Appendix B

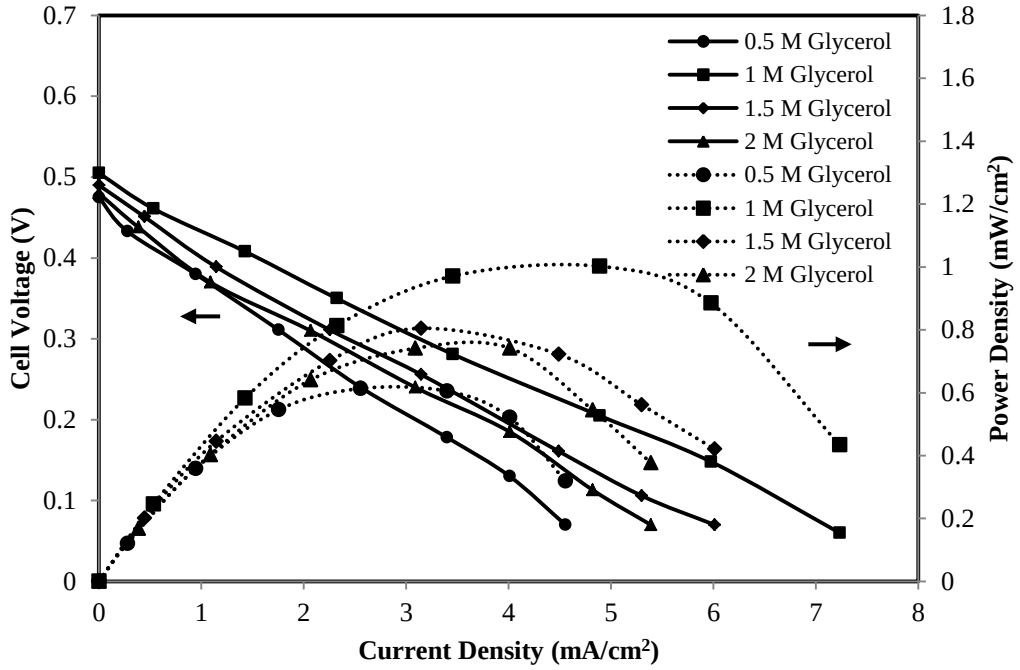

Figure B1 Current density vs. cell voltage and power density curves for varying glycerol concentration (A), B = 0.5 M KOH, C = 0.5 mg/cm^2 and D = 0.5 M KOH; Solid line - polarization curves, Dotted line- power density curves.

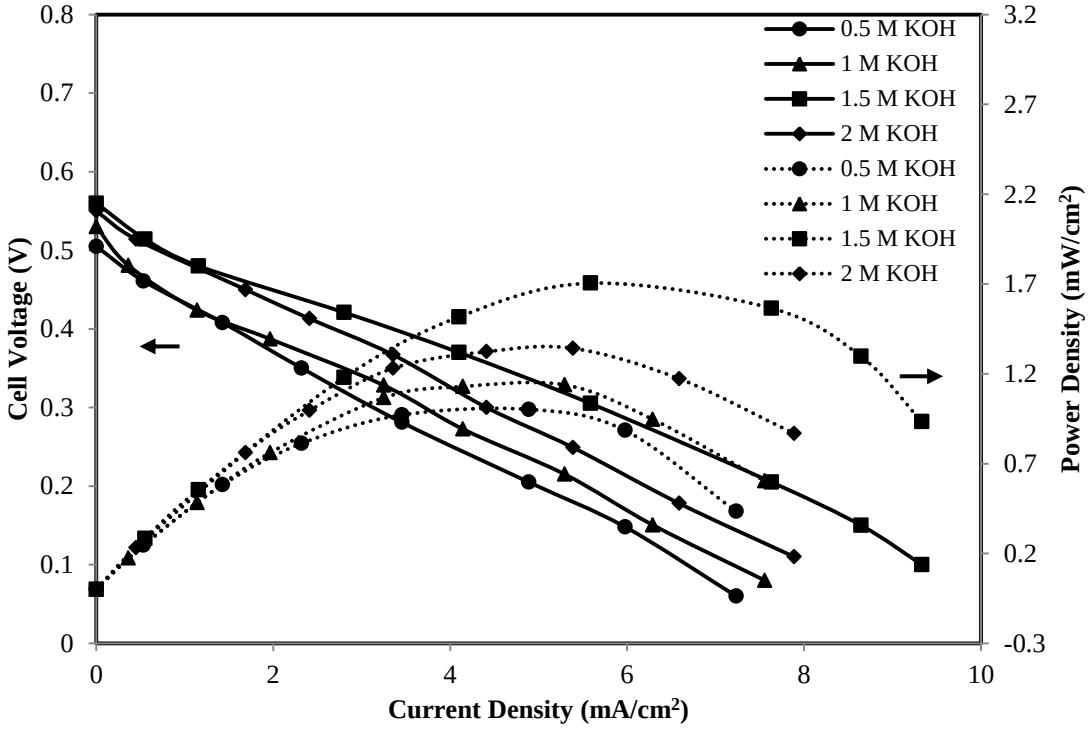

Figure B2 Current density vs. cell voltage and power density curves for varying anode electrolyte concentration (B), A= 1M glycerol, C = 0.5 mg/cm^2 and D = 0.5 M KOH; Solid line -polarization curves, Dotted line- power density curves.

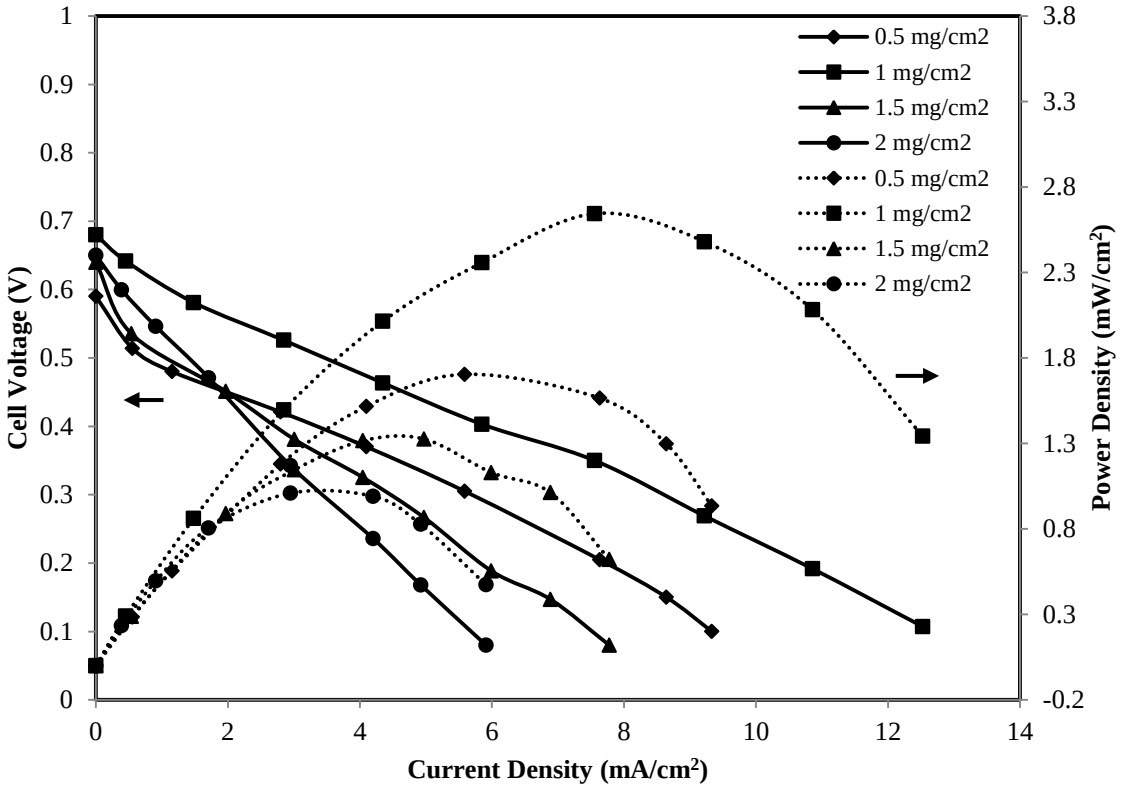

Figure B3 Current density vs. cell voltage and power density curves for varying anode electrocatalyst loading (C), A= 1M glycerol, B = 1.5 M KOH and D = 0.5 M KOH and mg/cm^2 ; Solid line -polarization curves, Dotted line- power density curves.

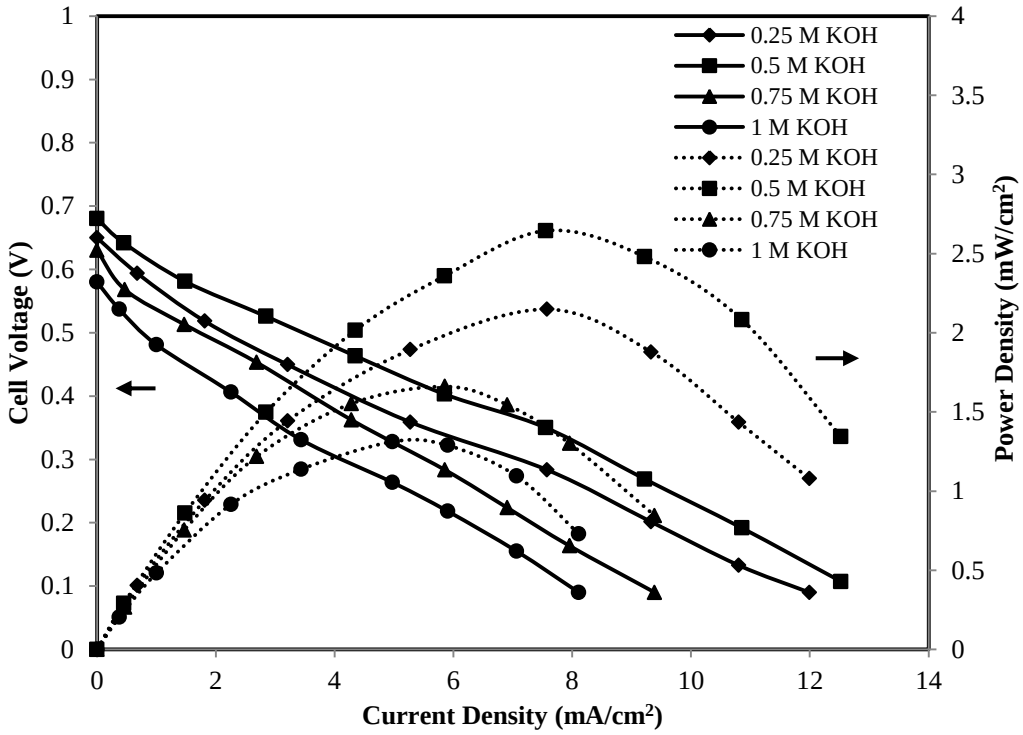

Figure B4 Current density vs. cell voltage and power density curves for varying cathode electrolyte concentration (D), A= 1M glycerol, B=1.5 M KOH, C=1 mg/cm^2 ; Solid line -polarization curves, Dotted line- power density curves.

APPENDIX C

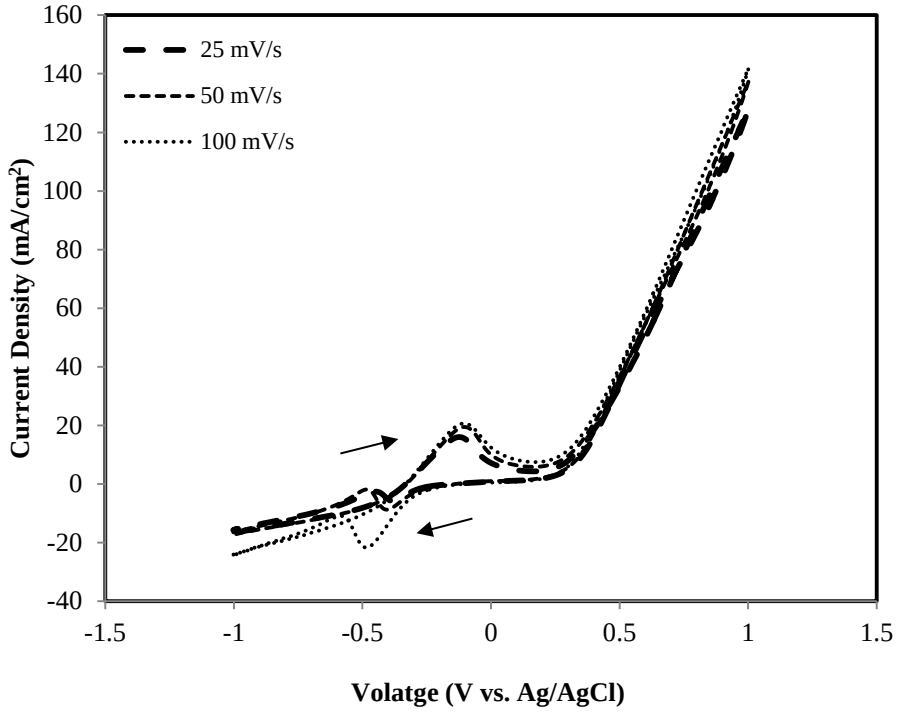

Figure C1 Cyclic voltammetry for 1 M glycerol mixed with 1 M KOH at different scan rate on Pd-Ni (16:4)/C anode at the loading of 1 mg/cm^2 at a temperature of 25 ^{o}C.

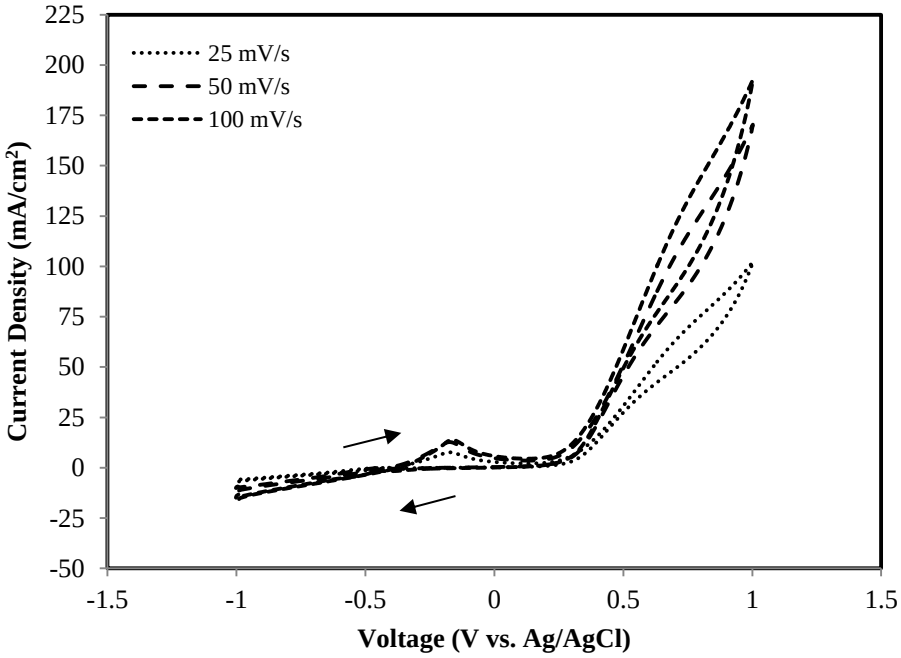

Figure C2 Cyclic voltammetry for 1 M glycerol mixed with 1 M KOH at different scan rate on Pd-Ni (10:10)/C anode at the loading of 1 mg/cm^2 at a temperature of 25 ^{o}C.

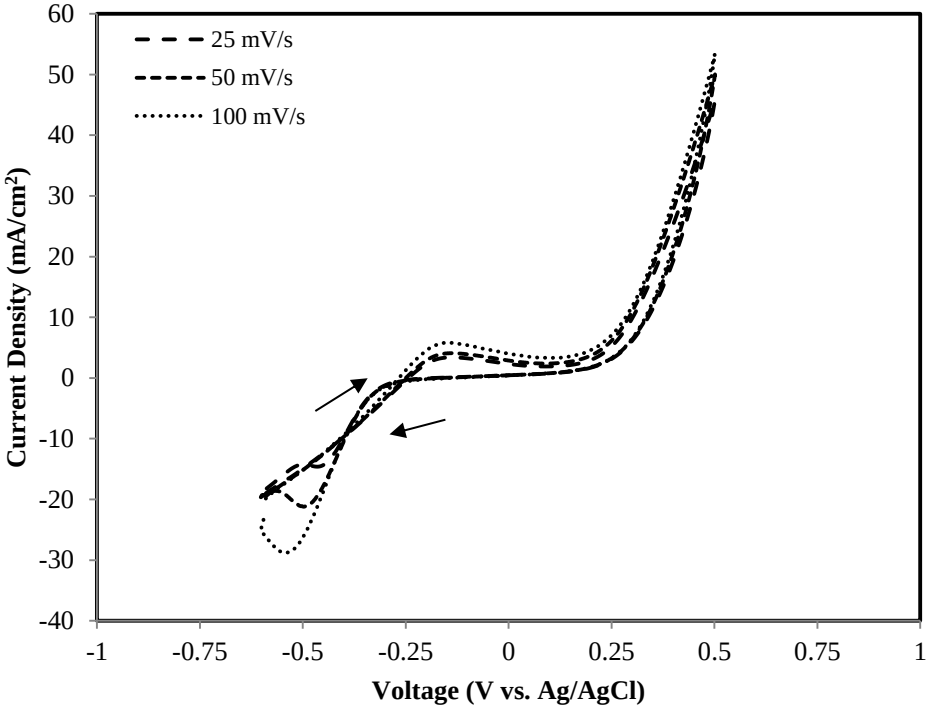

Figure C3 Cyclic voltammetry for 1 M glycerol mixed with 1 M KOH at different scan rate on Pd-Ni (4:16)/C anode at the loading of 1 mg/cm^2 at a temperature of 25 ^{o}C.

Appendix D

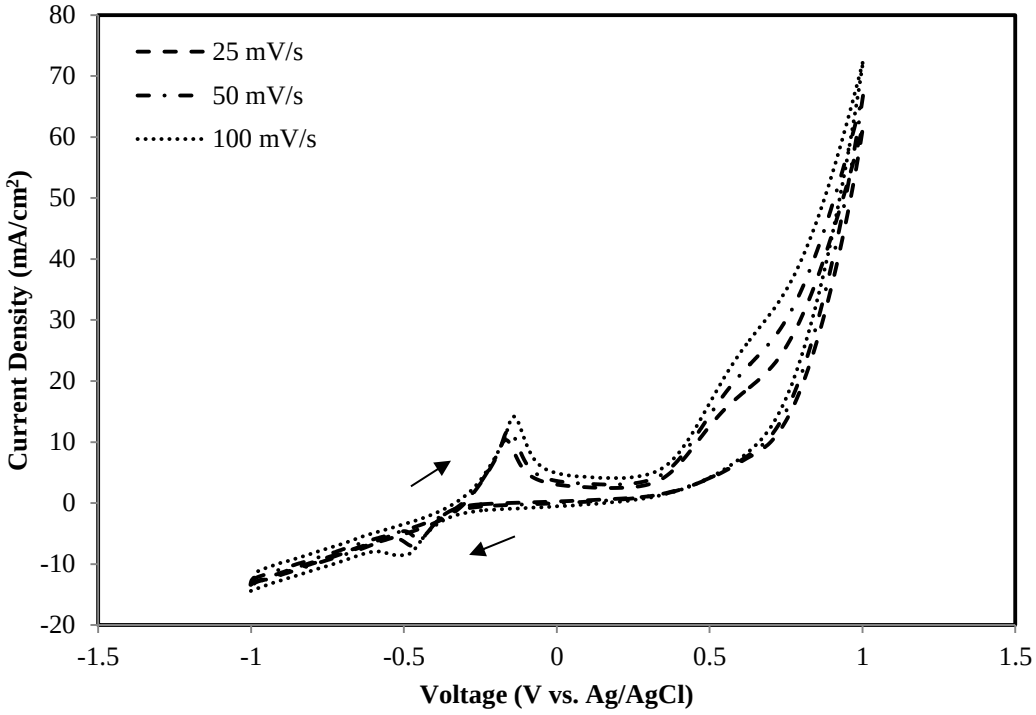

Figure D1 Cyclic voltammetry for 1 M glycerol mixed with 1 M KOH at different scan rate on Pd/C anode at the loading of 1 mg/cm^2 at a temperature of 25 ^{o}C.

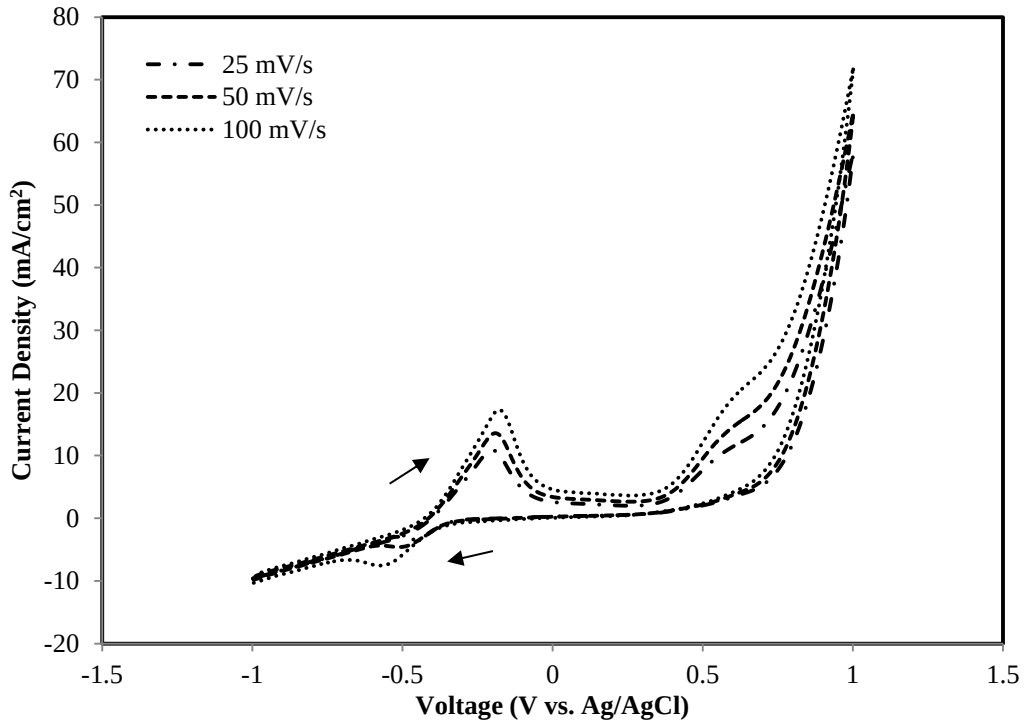

Figure D2 Cyclic voltammetry for 1 M glycerol mixed with 1 M KOH at different scan rate on Pd-Pt (16:4)/C anode at the loading of 1 mg/cm^2 at a temperature of 25 ^{o}C.

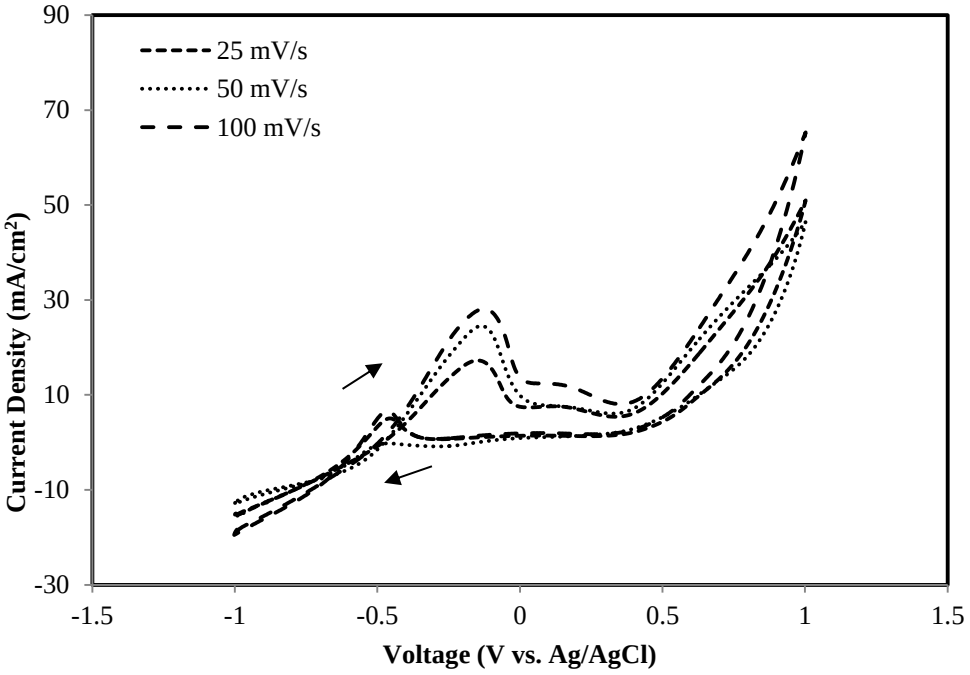

Figure D3 Cyclic voltammetry for 1 M glycerol mixed with 1 M KOH at different scan rate on Pd-Pt (10:10)/C anode at the loading of 1 mg/cm^2 at a temperature of 25 ^{o}C.

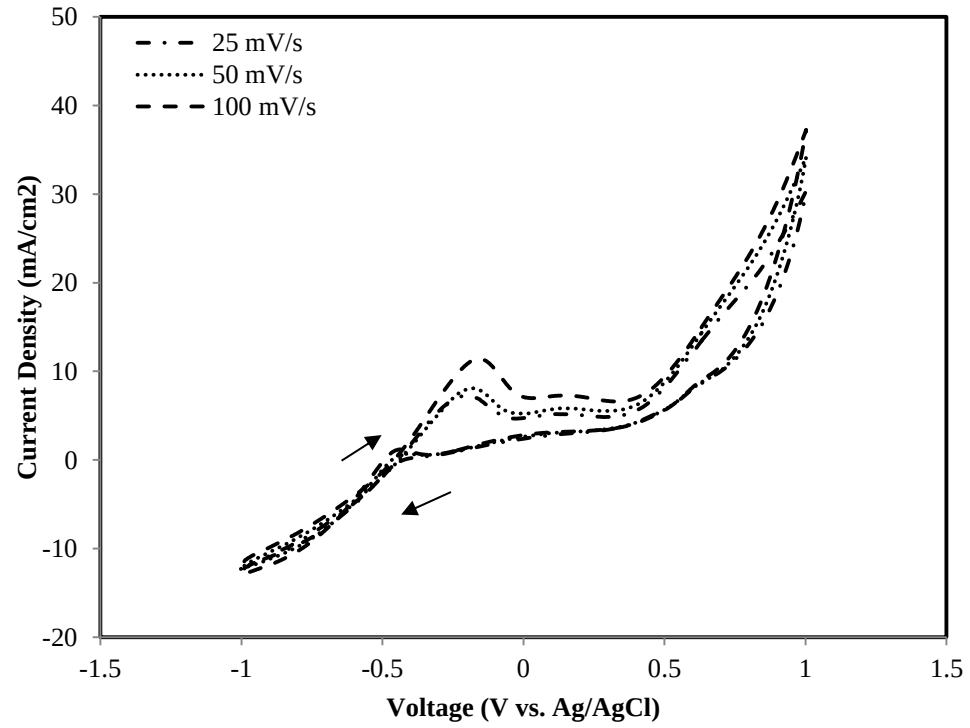

Figure D4 Cyclic voltammetry for 1 M glycerol mixed with 1 M KOH at different scan rate on Pd-Pt (4:16)/C anode at the loading of 1 mg/cm^2 at a temperature of 25 ^{o}C.

Appendix E

Table E1 Experimental data of polarization and power density curves for all 29 experiments obtained from BBD arrangements.

Run	Experimental conditions				Experimental results		
	A- glycerol conc. (M)	B-anode electrolyte conc.(M)	C- anode electrocatalyst loading (mg/cm^2)	D-cathode electrolyte conc. (M)	Cell Voltage (V)	Current density (mA/cm^2)	Power density (mW/cm^2)
1	1	1	1	0.75	0.66	0.00	0.00
					0.59	0.72	0.43
					0.50	2.07	1.04
					0.43	3.74	1.60
					0.35	5.14	1.81
					0.28	6.91	1.90
					0.20	8.58	1.70
					0.15	10.07	1.55
					0.09	11.22	0.99
2	1	1	1.5	0.5	0.60	0.00	0.00
					0.54	0.80	0.43
					0.48	1.65	0.79
					0.42	2.62	1.11
					0.36	3.76	1.35
					0.27	5.02	1.38
					0.19	6.01	1.13
					0.13	6.71	0.84
3	1	1.5	1.5	0.75	0.64	0.00	0.00
					0.60	0.66	0.39
					0.54	1.71	0.93
					0.47	3.28	1.55
					0.42	4.55	1.89
					0.36	5.88	2.09
					0.32	6.93	2.22
					0.24	8.41	1.98
					0.14	9.84	1.41
					0.08	10.89	0.87
4	1	2	0.5	0.5	0.56	0.00	0.00
					0.51	0.45	0.23
					0.46	0.99	0.46
					0.40	1.74	0.69
					0.34	2.80	0.95
					0.27	3.77	1.03
					0.20	5.51	1.10
					0.15	6.44	0.97
					0.12	7.00	0.84
5	1.00	2.00	1.00	0.25	0.68	0.00	0.00
					0.62	0.72	0.45
					0.56	2.35	1.33
					0.46	4.08	1.88
					0.39	5.91	2.33
					0.31	7.83	2.44
					0.24	9.41	2.21
					0.17	10.90	1.90
					0.13	12.05	1.53

Run	Experimental conditions				Experimental results		
	A- glycerol conc. (M)	B-anode electrolyte conc. (M)	C- anode electrocatalyst loading (mg/cm^2)	D-cathode electrolyte conc. (M)	Cell Voltage (V)	Current density (mA/cm^2)	Power density (mW/cm^2)
6	1.00	1.50	0.50	0.25	0.65	0.00	0.00
					0.59	0.77	0.45
					0.54	2.01	1.08
					0.47	3.55	1.67
					0.41	4.66	1.91
					0.37	5.66	2.11
					0.32	6.86	2.20
					0.25	8.36	2.09
					0.17	9.80	1.71
					0.08	11.11	0.89
7	1	1.5	1	0.5	0.68	0.00	0.00
					0.63	0.62	0.39
					0.59	1.23	0.72
					0.54	2.60	1.39
					0.48	4.02	1.94
					0.41	5.68	2.35
					0.36	7.37	2.65
					0.25	9.63	2.40
					0.18	11.33	2.03
					0.12	12.58	1.47
8	1	1.5	1	0.5	0.68	0.00	0.00
					0.64	0.45	0.29
					0.58	1.48	0.86
					0.53	2.85	1.50
					0.46	4.35	2.01
					0.40	5.85	2.36
					0.35	7.42	2.60
					0.27	9.13	2.46
					0.19	10.86	2.08
					0.11	12.53	1.34
9	1.5	1.5	0.5	0.5	0.61	0.00	0.00
					0.52	0.41	0.21
					0.44	1.06	0.47
					0.37	1.81	0.68
					0.30	3.04	0.90
					0.23	4.18	0.96
					0.18	5.12	0.90
					0.13	5.87	0.79
					0.09	6.56	0.59
10	1	2	1	0.75	0.68	0.00	0.00
					0.62	0.77	0.48
					0.54	2.35	1.28
					0.45	4.37	1.97
					0.38	6.15	2.35
					0.33	7.37	2.43
					0.24	8.88	2.17
					0.17	10.18	1.78
					0.12	11.52	1.35

Run	Experimental conditions				Experimental results		
	A- glycerol conc. (M)	B-anode electrolyte conc. (M)	C- anode electrocatalyst loading (mg/cm^2)	D-cathode electrolyte conc. (M)	Cell Voltage (V)	Current density (mA/cm^2)	Power density (mW/cm^2)
11	1	1.5	1	0.5	0.69	0.00	0.00
					0.62	0.61	0.38
					0.57	2.06	1.16
					0.51	3.07	1.57
					0.48	4.73	2.27
					0.44	5.72	2.52
					0.37	7.49	2.77
					0.27	9.14	2.47
					0.15	11.34	1.75
					0.11	12.78	1.41
12	1.5	2	1	0.5	0.64	0.00	0.00
					0.57	0.89	0.51
					0.51	2.11	1.08
					0.43	3.44	1.47
					0.34	5.33	1.84
					0.27	7.78	2.10
					0.19	9.44	1.81
					0.14	10.33	1.45
					0.07	11.67	0.82
13	1.5	1.5	1	0.75	0.67	0.00	0.00
					0.60	0.89	0.53
					0.53	2.14	1.14
					0.43	3.95	1.72
					0.37	6.28	2.32
					0.27	7.77	2.10
					0.23	8.89	2.04
					0.14	10.51	1.47
					0.10	11.68	1.16
14	1	1.5	0.5	0.75	0.58	0.00	0.00
					0.51	0.46	0.23
					0.44	1.12	0.49
					0.37	2.16	0.79
					0.32	3.29	1.04
					0.26	4.30	1.10
					0.19	5.17	1.00
					0.15	6.05	0.92
					0.09	6.90	0.61
15	0.5	1.5	1	0.25	0.65	0.00	0.00
					0.59	0.71	0.42
					0.50	1.83	0.92
					0.43	3.26	1.40
					0.37	4.66	1.71
					0.31	6.28	1.95
					0.23	7.69	1.80
					0.15	9.93	1.52
					0.09	11.22	0.99

Run	Experimental conditions				Experimental results		
	A-glycerol conc. (M)	B-anode electrolyte conc. (M)	C- anode electrocatalyst loading (mg/cm^2)	D-cathode electrolyte conc. (M)	Cell Voltage (V)	Current density (mA/cm^2)	Power density (mW/cm^2)
16	1	1.5	1.5	0.25	0.62	0.00	0.00
					0.56	0.77	0.43
					0.49	1.58	0.78
					0.44	2.35	1.03
					0.37	3.45	1.28
					0.29	4.78	1.40
					0.23	6.11	1.38
					0.16	7.39	1.21
					0.11	8.45	0.93
					0.06	9.51	0.52
17	0.5	1	1	0.5	0.61	0.00	0.00
					0.54	0.62	0.34
					0.49	1.76	0.86
					0.43	2.86	1.22
					0.36	3.87	1.39
					0.30	4.78	1.44
					0.23	6.40	1.48
					0.19	7.89	1.46
					0.15	9.11	1.32
					0.10	10.22	1.02
18	1	1.5	1	0.5	0.69	0.00	0.00
					0.64	0.57	0.36
					0.58	1.79	1.04
					0.53	2.79	1.47
					0.49	4.18	2.05
					0.42	6.02	2.54
					0.36	7.70	2.77
					0.28	9.27	2.58
					0.20	11.22	2.28
					0.12	12.75	1.56
19	1	1	1	0.25	0.64	0.00	0.00
					0.59	0.87	0.51
					0.50	2.29	1.15
					0.45	3.76	1.69
					0.35	6.00	2.10
					0.30	6.89	2.04
					0.24	8.50	2.01
					0.15	10.56	1.58
					0.09	11.67	1.03
20	1	1	0.5	0.5	0.60	0.00	0.00
					0.50	0.78	0.39
					0.40	1.78	0.71
					0.30	3.18	0.95
					0.24	3.92	0.94
					0.19	4.74	0.90
					0.15	5.33	0.80
					0.09	6.10	0.55

Run	Experimental conditions				Experimental results		
	A- glycerol conc. (M)	B-anode electrolyte conc. (M)	C- anode electrocatalyst loading (mg/cm^2)	D-cathode electrolyte conc. (M)	Cell Voltage (V)	Current density (mA/cm^2)	Power density (mW/cm^2)
21	0.5	1.5	1	0.75	0.64	0.00	0.00
					0.56	0.75	0.42
					0.48	2.26	1.07
					0.39	4.12	1.62
					0.32	5.61	1.80
					0.25	6.61	1.67
					0.20	8.25	1.66
					0.14	9.71	1.37
					0.09	10.89	0.97
22	1	1.5	1	0.5	0.69	0.00	0.00
					0.65	0.68	0.44
					0.58	2.01	1.17
					0.52	3.74	1.96
					0.48	4.91	2.36
					0.42	6.14	2.60
					0.36	7.70	2.77
					0.28	9.49	2.63
					0.22	10.91	2.44
					0.14	12.72	1.76
23	0.5	1.5	0.5	0.5	0.52	0.00	0.00
					0.44	0.68	0.30
					0.37	1.72	0.64
					0.32	2.78	0.89
					0.25	3.96	0.99
					0.21	4.80	1.01
					0.17	5.44	0.93
					0.12	6.11	0.73
24	1	1	1	0.5	0.58	0.00	0.00
					0.50	0.80	0.40
					0.45	1.56	0.70
					0.37	2.75	1.03
					0.34	3.84	1.30
					0.27	5.17	1.40
					0.20	6.44	1.29
					0.17	7.22	1.23
					0.11	8.00	0.88
25	1.5	1.5	1	0.25	0.63	0.00	0.00
					0.57	0.61	0.35
					0.50	1.61	0.80
					0.42	3.21	1.33
					0.36	4.31	1.57
					0.29	5.56	1.61
					0.23	7.06	1.64
					0.17	8.45	1.41
					0.13	9.36	1.19
					0.07	10.33	0.72

Run	Experimental conditions				Experimental results		
	A- glycerol conc. (M)	**B-anode electrolyte conc. (M)**	**C- anode electrocatalyst loading (mg/cm^2)**	**D-cathode electrolyte conc. (M)**	**Cell Voltage (V)**	**Current density (mA/cm^2)**	**Power density (mW/cm^2)**
26	0.5	2	1	0.5	0.57	0.00	0.00
					0.50	0.83	0.42
					0.44	2.00	0.88
					0.40	3.11	1.24
					0.36	4.44	1.60
					0.30	5.44	1.63
					0.24	6.89	1.65
					0.15	9.11	1.37
					0.10	10.00	1.00
27	1.5	1.5	1.5	0.5	0.66	0.00	0.00
					0.60	0.49	0.29
					0.53	1.34	0.71
					0.45	2.56	1.16
					0.40	3.72	1.49
					0.33	5.14	1.70
					0.24	6.41	1.52
					0.16	7.96	1.23
					0.09	8.93	0.83
28	1	2	1.5	0.5	0.55	0.00	0.00
					0.48	0.88	0.42
					0.42	1.81	0.76
					0.37	2.85	1.06
					0.32	3.89	1.24
					0.25	5.21	1.30
					0.18	6.33	1.13
					0.12	7.56	0.90
29	0.5	1.5	1.5	0.5	0.55	0.00	0.00
					0.49	0.44	0.22
					0.43	1.02	0.44
					0.36	1.84	0.65
					0.30	2.63	0.78
					0.25	3.22	0.80
					0.18	4.22	0.76
					0.14	5.17	0.71
					0.09	5.78	0.54

Abbreviation: conc., concentration.

Table E2 Comparison between actual power density and predicted power density of MFC at the optimum conditions for three repeated experiments.

No. of repeated experiments	OCV (V)	Experimental Power Density at optimum condition (mW/cm^2)	Standard Deviation (σ)	Predicted power density at optimum condition (mW/cm^2)	(%) error Between Predicted and Experimental value at optimum condition
1st Run	0.69	2.76	0.016	2.79	1.07
2nd Run	0.69	2.74			1.79
3rd Run	0.69	2.78			0.35

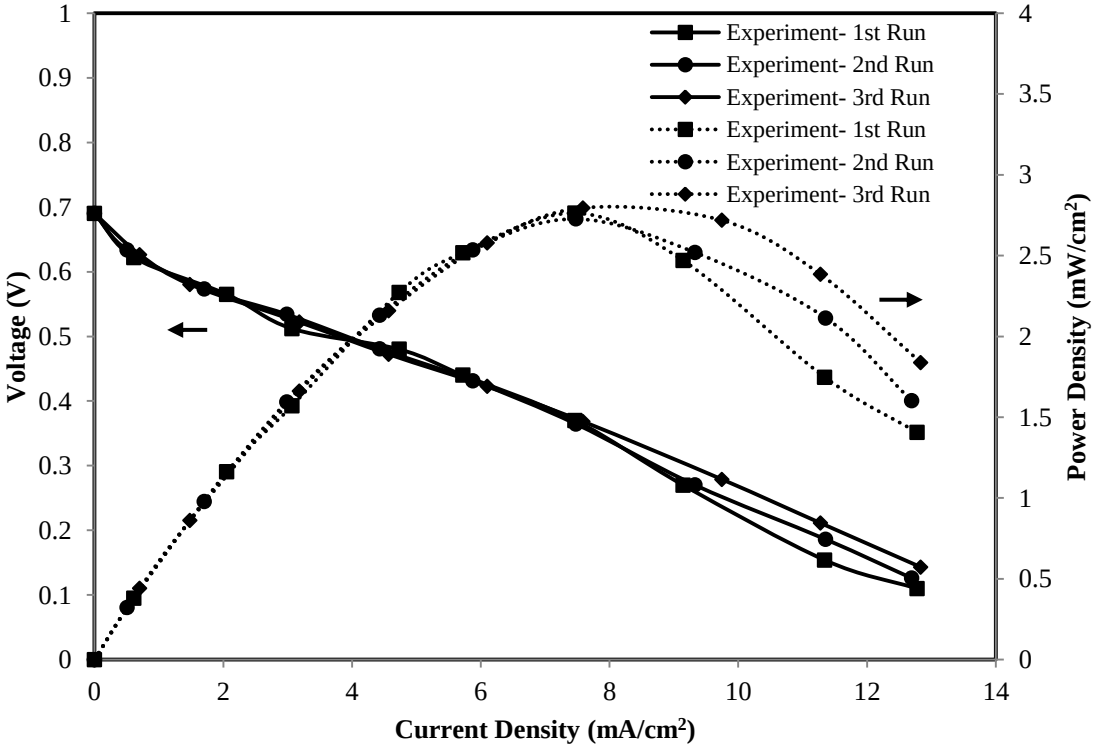

Figure E1 Current density vs. cell voltage and power density curves for three repeated experiments under optimum condition of MFC.

PUBLICATIONS FROM THE WORK

Journals:

1. Panjiara D, Pramanik H, "Electrooxidation study of glycerol on synthesized anode electrocatalysts Pd/C and Pd-Pt/C in a Y-shaped membraneless air-breathing microfluidic fuel cell for power generation" ***Ionics***, 26, (2020),2435–2452

2. Panjiara D, Pramanik H, "Optimization of Process Parameters Using Response Surface Methodology for Power Generation via Electrooxidation of Glycerol in T-Shaped Air Breathing Microfluidic Fuel Cell" ***International Journal of Hydrogen Energy*** 45, (2020), 33968-33979.

3. Panjiara D, Pramanik H, "Synthesis of Pd and Pt Based Low Cost Bimetallic Anode Electrocatalyst for Glycerol Electrooxidation in Membraneless Air Breathing Microfluidic Fuel Cell" ***Journal of Electrochemical Science and Technology***, 12(1), 2021, 38-57.

4. Panjiara D, Pramanik H, "Study the Effect of Calcium Hypochlorite and Air as Mixed Oxidant for Electrooxidation of Glycerol in an Air-Breathing Microfluidic Fuel Cell Using Synthesized low cost Pd-Ni/C Anode Electrocatalyst" ***Canadian journal of Chemical Engineering*** (https://doi.org/10.1002/cjce.24107).

Conferences:

1.Panjiara D, Pramanik H, *"*Membrane Less Microfluidic Fuel Cell: Future Source Of Energy For Portable Devices" 69th Annual session of IIChE, Chemcon 2016, Chennai, Dec 27-30, 2016.

2. Panjiara D, Pramanik H, "Air breathing Membraneless Microfluidic fuel cell Glycerol as fuel" 70th Annual session of IIChE, Chemcon 2017, Haldia, West Bengal, Dec 27-30, 2017.

3. Panjiara D, Pramanik H, "Optimization of Process parameters using RSM for Electrooxidation of Glycerol in Air Breathing Microfluidic Fuel Cell*"* 71th Annual session of IIChE, Chemcon 2018, NIT Jalandhar, Dec 27-30, 2018.

4. Panjiara D, Pramanik H, *"*Electrooxidation study of glycerol on synthesized anode electrocatalysts Pd/C and Pt-Pd/C in a membraneless air-breathing microfluidic fuel cell for power generation*"* 3rd SEE SDEWES conference, Novid Sad, Serbia, June 30 - July 4, 2018,