

Ahmed Bahgat

Senior Researcher



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Professional Experience

December 2013 till Now	Centre of Advanced Material, Qatar University Senior Researcher
August 2008 – December 2013	Safety Engineer 1-Egyptian Company for Metro from 03/2010 to 12-2013 2-DSD Ferrometalco, Egypt from 08/2008 to 02/2010
December 2005 - April 2007	Obligated Military service

Education

2023	PhD in inorganic chemistry, Ain Shams University
March-2010-August 2013:	M.Sc in Inorganic Chemistry Zagazig University, Egypt Faculty of Science, Egypt
September 2000-May 2004:	B.Sc in Chemistry Grade V.Good

- **Research experience**

- I am broadly interested in corrosion protection of metal and metal alloys using various techniques such as corrosion inhibitors and different kinds of organic and metallic coatings. In addition, I expanded my research to synthesize electrode materials of different types of applications in electrochemistry.
- Published 39 articles with total citations of 966 and an *h*-index of 17 according to google scholar <https://scholar.google.ca/citations?user=fEVr4iMAAAAJ&hl=en>

- **Funded Grant**

- NPRP: Al-Thani, N. J. (Lead Principal Investigator), **Ahmed Bahgat Radwan (Principal Investigator)**, Noora Al-Qahtani (Principal Investigator), Bhadra, J. (Principal Investigator), "Study of the relationship between the passive behavior and stress corrosion cracking susceptibility in high strength martensitic modified stainless steels exposed to sour service conditions," Local(Excluding Qatar University), 592,320 \$. (January 5, 2020 - January 5, 2023).
- **IRCC-2021-008** Khaled Youssef (LPI), **Ahmed Bahgat Radwan (Principal Investigator)**, Aboubakr M. Abdullah Ali (Principal Investigator), "Fabrication of novel high-strength biodegradable nanocrystalline magnesium alloys for orthopedic applications." Qatar University, 120,000 \$.
- Al-Qahtani, N. H. S. (Lead Principal Investigator), **Ahmed Bahgat Radwan** (Co-Principal Investigator), "Smart super hydrophobic antifouling coatings for seawater systems," Local(Excluding Qatar University), 30,000.00US. (February 1, 2023 - Present). **UREP29-159-2-043**.

- **Industrial projects experience**

- Failure Analysis of 316L Air Cooler Stainless Steel Tube in Qatar gas.
- Failure analysis of heat bundle tube of incoloy 800 in low-pressure steam generator in Qatar gas.
- Failure analysis of heat exchanger tube (aluminum brass alloy), in water and electricity company.
- Water analysis of RAF A3 in Ras aboufontas (Kahramaa)
- Failure analysis of high transmission line (Kahramaa)

Publications

- 1- Environmental factors affecting the corrosion behaviour of reinforcing steel. V. Role of chloride and sulphate ions in the corrosion of reinforcing steel in saturated Ca(OH)₂ solutions. S.M. Abd El Haleem, S. Abd El Wanees, **A. Bahgat**. **Corrosion Science**. 75 (2013) 1–15.
- 2- Environmental factors affecting the corrosion behaviour of reinforcing steel. VI. Benzotriazole and its derivatives as corrosion inhibitors of steel. S. M. Abd -Haleem S. Abd El Wanees, and **A. Bahgat**. **Corrosion Science**, 87 (2014) 321-333.
- 3- **A. Bahgat Radwan**, R. A. Shakoor, Anton Popelka. Improvement in Properties of Ni-B Coatings by the Addition of Mixed Oxide Nanoparticles. **Int. J. Electrochem. Sci.**, 10 (2015) 7548 – 7562.
- 4- **A. Bahgat Radwan**, Aboubakr M. Abdullah, Hans J. Roven¹, Adel M. Mohamed, Mobbassar Hassan SK. Failure Analysis of 316L Air Cooler Stainless Steel Tube in a Natural Gas Production Field. **Int. J. Electrochem. Sci.**, 10 (2015) 7606 – 7621.
- 5- **A. Bahgat Radwan**, Adel M.A. Mohamed, Aboubakr M. Abdullah, Mariam A. Al-Maadeed. Corrosion protection of electrospun PVDF–ZnO superhydrophobic coating. **Surface and Coatings Technology** 289 (2016) 136-143.
- 6- S. Abd El Wanees, **A. Bahgat Radwan**, M.A. Alsharif, S.M. Abd El Haleem. Initiation and inhibition of pitting corrosion on reinforcing steel under natural corrosion conditions. **Materials Chemistry and Physics** 190 (2017) 79-95.
- 7- **A. Bahgat Radwan**, Mostafa H. Sliem, Paul C. Okonkwo, Mohamed F. Shibl and Aboubakr M. Abdullah. Corrosion inhibition of API X120 steel in a highly aggressive medium using stearamidopropyl dimethylamine. **Journal of Molecular Liquids**, 236(2017) 220–231.
- 8- Moinuddin M. Yusuf, **A. Bahgat Radwan**, R. A. Shakoor, Muhammad Awais, Aboubakr M. Abdullah, M. F. Montemor, Ramazan Kahraman. Ni-B/Ni-P-CeO₂ duplex coatings with improved hardness and anticorrosion properties. **Journal of Applied Electrochemistry**, 48 (2018) 391–404.
- 9- **A. Bahgat Radwan**, Aboubakr M. Abdullah and Nasser A Al-Nuaimi. Recent advances in corrosion resistant superhydrophobic coatings. **Corrosion Rev** 36 (2018) 127–153.
- 10- **A. Bahgat Radwan**, Aboubakr M. Abdullah, Adel M. A. Mohamed and Mariam A. Al-

- Maadeed. New Electrospun Polystyrene/Al₂O₃ Nanocomposite Superhydrophobic Coatings; Synthesis, Characterization, and Application. **Coatings** 8 (2018) 65.
- 11- **A. Bahgat Radwan**, Aboubakr M. Abdullah, Mohammad K. Hassan. The missing piece of the puzzle regarding the relation between the degree of superhydrophobicity and the corrosion resistance of superhydrophobic coatings. **Electrochemistry Communications** 91 (2018) 41–44.
 - 12- Khoulood Jlassi, **A. Bahgat Radwan**, Kishor Kumar Sadasivuni, Miroslav Mrlik, Aboubakr M. Abdullah, Mohamed M. Chehimi & Igor Krupa, Anti-corrosive and oil sensitive coatings based on epoxy/polyaniline/magnetite-clay composites through diazonium interfacial chemistry, **Scientific Reports**, 8 (2018) 13369.
 - 13- **A. Bahgat Radwan**, K. Ali, R.A. Shakoor, H. Mohammed, T. Alsalama, R. Kahraman, M.M. Yusuf, A.M. Abdullah, M. Fatima Montemor, M. Helal, Properties enhancement of Ni-P electrodeposited coatings by the incorporation of nanoscale Y₂O₃ particles, **Applied Surface Science**, 457 (2018) 956-967.
 - 14- Muhsen El-Haddad, **A. Bahgat Radwan**, Mostafa sliem, Walid Hassan, and Aboubakr Abdullah. Highly efficient eco-friendly corrosion inhibitor for mild steel in 5 M HCl at elevated temperatures: experimental & molecular dynamics study. **Scientific Reports**, 9 (2019) 3695.
 - 15- Mostafa sliem, Mohamed Afifi, **A. Bahgat Radwan**, Eman Fayyad, Mohamed Shibl, Fakiha Heakal, and Aboubakr Abdullah. AEO7 Surfactant as an Eco-Friendly Corrosion Inhibitor for Carbon Steel in HCl. **Scientific Reports**, 9 (2019) 2319.
 - 16- F. Ubaid, **A. Bahgat Radwan**, N. Naeem, R.A. Shakoor, Z. Ahmad, M.F. Montemor, R. Kahraman, A.M. Abdullah, A. Soliman, Multifunctional self-healing polymeric nanocomposite coatings for corrosion inhibition of steel, **Surface and Coatings Technology**, 372 (2019) 121-133.
 - 17- **A. Bahgat Radwan**, Mostafa H. Sliem, Noor S. Yusuf, Nasser A. Alnuaimi & Aboubakr M. Abdullah. Enhancing the corrosion resistance of reinforcing steel under aggressive operational conditions using behentrimonium chloride. **Scientific Reports** 9 (2019) 18115.
 - 18- **A. Bahgat Radwan**, R.A.Shakoor. Aluminum nitride (AlN) reinforced electrodeposited Ni–B nanocomposite coatings. **Ceramics international** 46 (2020) 9863-9871.
 - 19- Khuram Shahzad, Mostafa H. Sliem, R.A. Shakoor, **A. Bahgat Radwan**, Ramazan Kahraman, MalikAdeel Umer, Umair Manzoor & Aboubakr M. Abdullah. Electrochemical and thermodynamic study on the corrosion performance of API X120 steel in 3.5% NaCl solution, **Scientific Reports** 10 (2020) 4314.
 - 20- Mostafa H. Sliem, **A. Bahgat Radwan**, Farida S. Mohamed, Nasser A. Alnuaimi & Aboubakr M. Abdullah. An efficient green ionic liquid for the corrosion inhibition of reinforcement steel in neutral and alkaline highly saline simulated concrete pore solutions. **Scientific Reports** 10 (2020) 14565.
 - 21- Ola Al-Jamal, Hadeel Al-Jighefee, NadinYounes, Roba Abdin, Maha A. Al-Asmakh, **A. Bahgat Radwan**, Mostafa H. Sliem, Amin F. Majdalawieh, Gianfranco Pintus, Hadi M.Yassine, Aboubakr M. Abdullah, Sahar I. Da'as, Gheyath K. Nasrallah. Organ-specific toxicity evaluation of stearamidopropyl dimethylamine (SAPDMA) surfactant using zebrafish embryos. **Science of the Total Environment** 741 (2020) 140450.
 - 22- M. Al-Asmakh, A.F. Majdalawieh, A.M. Abdullah, N. Younes, S.I. Da'as, **A. Bahgat Radwan**, M.H. Sliem, H. Ech-Cherif, G. Pintus, G.K. Nasrallah, AEO-7 surfactant is “super toxic” and induces severe cardiac, liver, and locomotion damage in zebrafish embryos, **Environmental Sciences Europe**, 32 (2020) 149.
 - 23- Khuram Shahzad; **A. Bahgat Radwan**; Osama Fayyaz; Madeeha Uzma; M. Adeel Umer; M. N. Baig; A. Raza. Improved Properties of Pulse Electrodeposited Ni-P/TiC Nanocomposite Coatings. **Ceramics international** 47 (2021) 19123-19133.
 - 24- **A. Bahgat Radwan**, C.A. Mannah, M.H. Sliem, N.H.S. Al-Qahtani, P.C. Okonkwo, E. Berdimurodov, A.M. Mohamed, A.M. Abdullah, Electrospun highly corrosion-resistant polystyrene–nickel oxide superhydrophobic nanocomposite coating, **Journal of Applied Electrochemistry**, (2021).
 - 25- O. Fayyaz, **A. Bahgat Radwan**, M.H. Sliem, A.M. Abdullah, A. Hasan, R.A. Shakoor, Investigating the Properties of Electrodeposited of Ni-P-ZrC Nanocomposite Coatings, **ACS Omega**, 6 (2021) 33310-33324.
 - 26- P.C. Okonkwo, W. Emori, P.C. Uzoma, I.B. Mansir, **Ahmed Bahgat Radwan**, O.O. Ige, A.M. Abdullah, A review of bipolar plates materials and graphene coating degradation mechanism in proton exchange membrane fuel cell, **International Journal of Energy Research**, (2021).
 - 27- **Ahmed Bahgat Radwan***, S. Paramparambath, J.-J. Cabibihan, A.K. Al-Ali, P. Kasak, R.A. Shakoor, R.A. Malik, S.A. Mansour, K.K. Sadasivuni*, Superior Non-Invasive Glucose Sensor Using Bimetallic CuNi Nanospecies Coated Mesoporous Carbon,

- Biosensors** 11 (2021) 463.
- 28- **A. Bahagt Radwan**, A.M. Moussa, N.H. Al-Qahtani, R. Case, H. Castaneda, A.M. Abdullah, M.A.M. El-Haddad, J. Bhadra, N.J. Al-Thani, Evaluation of the Pitting Corrosion of Modified Martensitic Stainless Steel in CO₂ Environment Using Point Defect Model, **Metals**, 12 (2022) 233.
 - 29- **A. Bahagt Radwan**, S.I. El-Hout, M.A.M. Ibrahim, E.H. Ismail, A.M. Abdullah, Superior Corrosion and UV-Resistant Highly Porous Poly(vinylidene fluoride-co-hexafluoropropylene)/alumina Superhydrophobic Coating, **ACS Applied Polymer Materials**, 4 (2022) 1358-1367.
 - 30- N. Tabassum, R. Pothu, A. Pattnaik, R. Boddula, P. Balla, R. Gundeboyina, P. Challa, R. Rajesh, V. Perugopu, N. Mameda, **A. Bahgat. Radwan**, A.M. Abdullah, N. Al-Qahtani, Heterogeneous Catalysts for Conversion of Biodiesel-Waste Glycerol into High-Added-Value Chemicals, **Catalysts**, 12 (2022) 767.
 - 31- P.C. Okonkwo, I.B. Mansir, E.M. Barhoumi, W. Emori, **A. Bahgat Radwan**, R.A. Shakoor, P.C. Uzoma, M.R. Pugalenti, Utilization of renewable hybrid energy for refueling station in Al-Kharj, Saudi Arabia, **International Journal of Hydrogen Energy**, 47 (2022) 22273-22284.
 - 32- M. Nawaz, **A. Bahgat Radwan**, P.K. Kalambate, W. Laiwattanapaisal, F. Ubaid, H.M. Akbar, R.A. Shakoor, R. Kahraman, Synergistic Behavior of Polyethyleneimine and Epoxy Monomers Loaded in Mesoporous Silica as a Corrosion-Resistant Self-Healing Epoxy Coating, **ACS Omega**, 7 (2022) 31700-31712.
 - 33- M. Farhan, O. Fayyaz, M. Nawaz, **A. Bahgat Radwan**, R.A. Shakoor, Synthesis and properties of electroless Ni-P-HfC nanocomposite coatings, **Materials Chemistry and Physics**, 291 (2022) 126696.
 - 34- **A.B. Radwan**, A.M. Moussa, N.H. Al-Qahtani, R. Case, H. Castaneda, A.M. Abdullah, M.A.M. El-Haddad, J. Bhadra, N. Al-Thani, Y. Ding, Effect of the temperature on the passivity of the modified martensitic stainless steels, **Corrosion Engineering, Science and Technology**, (2022) 1-13.
 - 35- P.K. Kalambate, P. Thirabowonkitphithan, P. Kaewarsa, K. Permpoka, **A.B. Radwan**, R.A. Shakoor, R.P. Kalambate, H. Khosropour, Y. Huang, W. Laiwattanapaisal, Progress, challenges, and opportunities of two-dimensional layered materials based electrochemical sensors and biosensors, **Materials Today Chemistry**, 26 (2022) 101235.
 - 36- R. Pothu, N. Mameda, H. Mitta, R. Boddula, R. Gundeboyina, V. Perugopu, **A.B. Radwan**, A.M. Abdullah, N. Al-Qahtani, High Dispersion of Platinum Nanoparticles over Functionalized Zirconia for Effective Transformation of Levulinic Acid to Alkyl Levulinate Biofuel Additives in the Vapor Phase, **Journal of Composites Science**, 6 (2022) 300.
 - 37- R. Pothu, P. Challa, R. Rajesh, R. Boddula, R. Balaga, P. Balla, V. Perugopu, **A.B. Radwan**, A.M. Abdullah, N. Al-Qahtani, Vapour-Phase Selective Hydrogenation of γ -Valerolactone to 2-Methyltetrahydrofuran Biofuel over Silica-Supported Copper Catalysts, **Nanomaterials**, 12 (2022) 3414.
 - 38- P.C. Okonkwo, E.M. Barhoumi, I. Ben Belgacem, I.B. Mansir, M. Aliyu, W. Emori, P.C. Uzoma, W.H. Beitelmal, E. Akyüz, **A.B. Radwan**, R.A. Shakoor, A focused review of the hydrogen storage tank embrittlement mechanism process, **International Journal of Hydrogen Energy**, (2023).
 - 39- Kallambadi Sadashivappa, P., R. Venkatachalam, R. Pothu, R. Boddula, P. Banerjee, R. Naik, **A. B. Radwan** and N. Al-Qahtani (2023). "Progressive Review of Functional Nanomaterials-Based Polymer Nanocomposites for Efficient EMI Shielding." **Journal of Composites Science** 7(2): 77.
 - 40- R. Pothu, H. Mitta, P. Banerjee, R. Boddula, R.K. Srivastava, P.K. Kalambate, R. Naik, **A. Bahgat Radwan**, N. Al-Qahtani, Insights into the influence of Pd loading on CeO₂ catalysts for CO₂ hydrogenation to methanol, **Materials Science for Energy Technologies**, 6 (2023) 484-492.
 - 41- **A.B. Radwan**, P.C. Okonkwo, S. Murugan, G. Parande, M. Taryba, M.F. Montemor, L. Al-Mansoori, M.A. Elrayess, N. Al-Qahtani, M. Gupta, K.M. Youssef, R. Case, R.A. Shakoor, A.M. Abdullah, Evaluation of the Influence of Eggshell (ES) Concentration on the Degradation Behavior of Mg-2.5Zn Biodegradable Alloy in Simulated Body Fluid, **ACS Biomaterials Science & Engineering**, 9 (2023) 2376-2391.
 - 42- **A.B. Radwan**, A.M. Moussa, N.H. Al-Qahtani, R. Case, H. Castaneda, A.M. Abdullah, M.A.M. El-Haddad, J. Bhadra, N. Al-Thani, Y. Ding, Effect of the temperature on the passivity of the modified martensitic stainless steels, **Corrosion Engineering, Science and Technology**, 58 (2023) 156-168.
 - 43- Jhilmil Swapnalin ; Bhargavi Koneru; Ramyakrishna Pothu; Prasun Banerjee; Rajender Boddula; **Ahmed Bahgat Radwan**; Noora Al-Qahtani. Surface modification of Ti₃C₂T_x using terminal groups and heteroatoms with excellent electrochemical performance in

Book Chapters

- 1- A.M.A Mohamed, Aboubakr Moustafa Abdullah, Mariam Al-Maadeed, **Ahmed Bahgat** Fundamental, fabrication and applications of superhydrophobic surfaces. IGI Global publisher (2016).

Conference Proceedings

- 1- Study of In Vitro Biodegradation Behavior of Mg–2.5Zn–xES Composite. Srinivasan Murugan, Paul C. Okonkwo, **Ahmed Bahgat**, Gururaj Parande, Aboubakr M. Abdullah, and Manoj Gupta. DOI :10.1007/978-3-030-36647-639_ .In book: Magnesium Technology 2020.
- 2- **Radwan, A. B.**, Ali, K., Ahmed, S. E., Mahmoud, A. A., Kahraman, R., Shakoor, R. A., Montemor, F. M. (2018). Novel Ni-B/AlN nanocomposite coatings for oil and gas industry. NACE - International Corrosion Conference Series (vol. 2018-April). https://api.elsevier.com/content/abstract/scopus_id/85053555275.
- 3- Yusuf, M. M., **Radwan, A. B.**, A. M., Shakoor, R. A., Kahraman, R., Ali, K., Montemor, M. F. (2017). Novel Ni based duplex coatings for anticorrosion applications. ECS Transactions (10th ed., vol. 80, pp. 593-602). https://api.elsevier.com/content/abstract/scopus_id/85046123029.
- 4- New Superhydrophobic Coatings for Protection Against Corrosion October 2014 Conference: The 226th Electrochemical Society At: La Sociedad Mexicana de Electroquímica Joint International Meeting, Cancun, Mexico, A.M.A Mohame,d Aboubakr M. Abdullah, **Ahmed Bahgat**, Mariam Al-Ali AlMa'adeed

Title (Poster presentation)

- 1- **A. Bahgat Radwan**. Study of the In Vitro Biodegradation Behavior of Mg–2.5Zn–xES. Composite for Orthopedic Application. Chemicals & Materials for Emergent Technologies | Qatar University (15-17/2020).
- 2- **A. Bahgat Radwan**. Multifunctional self-healing polymeric nanocomposite coatings for corrosion inhibition of steel. Annual Research Forum & Exhibition 2020. QU. Qatar (October 2020)
- 3- **Radwan, A. B.** A. M. (1st uthor), Annual research Forum 2019 (Barzan Award), "Highly Corrosion Resistance and UV Durable of Novel Superhydrophobic Coating on Al alloy," QU, Qatar. (March 29, 2019).
- 4- **Radwan, A. B.** (1stAuthor & Presenter), Qatar Foundation Annual Research Conference ARC 18, "Novel Ni-B/AlN nanocomposite coatings for oil and gas industry," QNRF, Qatar. (March 2018).
- 5- **Radwan, A. B.** (1stAuthor & Presenter), Materials Science and Engineering Symposium 2018, "One step fabrication of SHS of PVDF-HFP/Al₂O₃ with high corrosion resistance and UV durability on aluminum substrate," QU, Qatar. (February 2018).
- 6- **Radwan, A. B.** (1stAuthor & Presenter), Qatar-UK Research Networking Program Materials, "Corrosion Resistant and UV Durable PVDF-Co-HFP/Al₂O₃," QU, Qatar.(2017) .
- 7- **Radwan, A. B.** (1stAuthor & Presenter), QU Annual Research Forum 2017 Session, "Failure analysis of two different cases of incoloy 800 in low-pressure steam generator," QU, Qatar (2017).

- 8- **Radwan, B.** (1st Author & Presenter), Technical Workshop on “Corrosion of steel and its smart protection strategies” on 6th April 2017, "Superhydrophobic coatings: design, optimization and challenges," QU, Qatar. (2017).
- 9- **A. B. Radwan** (Author & Presenter), **A. B. A. M.** (Co-Author), Ali, A. M. A. (Co-Author), Al-Qahtani, N. H. S. (Leader), Qatar University Annual Research Forum (QUARFE) 2022, "Vapour phase selective catalytic hydrogenation of γ -valerolactone to 2-methyltetrahydrofuran biofuel," QU, Qatar. (October 3, 2022).
- 10- Fayyaz, O. (Author & Presenter), Shakoor, A. (Co-Author), Shahzad, K. (Co-Author), **Radwan, A. B. A. M. (Co-Author)**, Umer, M. Adeel (Co-Author), 2nd Corrosion and Materials Degradation Web Conference, "Synthesis and properties of titanium carbide incorporated nickel phosphorus-based nanocomposite coatings," QNRF, Qatar. (July 7, 2022).
- 11- **A. B. Radwan** (Author & Presenter), Sadasivuni, K. K. (Co-Author), Shakoor, A. (Co-Author), Kasak, P. (Co-Author), Cabibihan, J.-J. (Co-Author), Al-Ali, A. K. A. M. (Co-Author), Malik, R. (Co-Author), ACS MENA Conference, "Superior Non-Invasive Glucose Sensor Using Bimetallic CuNi Nano species Coated Mesoporous Carbon," QNRF, Qatar. (May 11, 2022).
- 12- **Radwan, A. B.** (Author & Presenter), P. C. O. (Co-Author), S. M. (Co-Author), M. T. (Co-Author), M. Fatima Montemor (Co-Author), L.-M. (Co-Author), M. A. E. (Co-Author), Al-Qahtani, N. H. S. (Co-Author), G. P. (Co-Author), M. G. (Co-Author), K. M. Y. (Co-Author), R. C. (Co-Author), Shakoor, A. (Co-Author), Ali, A. M. A. (Co-Author), ACS Research Conference: Chemistry and Chemical Engineering in MENA, "Evaluation of the influence of the eggshell (ES) concentration on the in-vitro biodegradation behavior of Mg-2.5 Zn alloy in a simulated body fluid," Other, Qatar. (May 11, 2022).
- 13- **Radwan, A. B.** (Author & Presenter), P. O. (Co-Author), G. M. (Co-Author), Al-Qahtani, N. H. S. (Author & Presenter), R. S. (Co-Author), Ali, A. M. A. (Co-Author), Qatar University Annual Research Forum (QUARFE) 2021, "Study of the In Vitro Biodegradation Behavior of Mg-2.5Zn-xES Composite for Orthopedic Application," QU, Qatar, Qatar. (October 2021).

Awards

- Awarded 2nd prize in the materials science and engineering Symposium 2018 Qatar University and Texas A&M University at Qatar.
- Awarded 2nd prize in ” at first “Materials of the Future: Smart Applications in Science and Engineering” at Qatar University and Texas A&M University at Qatar (29-03-2021).
- Awarded 2nd prize Online conference on emerging and enabling materials (24- 11-2021).
- Canadian Special Award from Innovation Initiative Co-operative Inc. “The Inventors Circle”, Toronto International Society of Innovation & Advanced Skills (TISIAS), iCAN 2022. (September 13, 2022).
- Gold Medals, 7th International Invention Innovation Competition in Canada, iCAN 2022., Toronto International Society of Innovation & Advanced Skills (TISIAS), iCAN 2022. (September 13, 2022).