Dr. Imran Shafi

Ph.D. in Physics | B.Ed. | Electrochemical Materials Researcher | Physics Educator

Contact Information:

Phone: +923329117308 (Call & WhatsApp)
Email: imran.kashmir@yahoo.com

Research Interests:

Electrochemical Technologies: Energy storage & conversion, Water-Energy nexus, Electrochemical Capacitive Mixing, Capacitive Dionization, Ionic sensing, Resource recovery from brine, Hydrogen prodcuction and advanced nanomaterials (graphene, MXenes, MOFs/COFs, metal oxides).

Academic Background:

Ph.D. in Physics | Zhengzhou University, Henan, China (Sep 2018 – Dec 2022)
Supervisor: Prof. Erjun Liang | **Co-supervisor:** Prof. Baojun Li
Thesis: *Transition Metal Oxide Nanomaterials for Electrochemical Energy Storage in Aqueous Electrolyte Supercapacitors.*

Research directions: Energy Storage | Supercapacitors-Supercapbatteries | Nanosynthesis
Significant Accomplishments: 13 publications (mostly lead author) | Participated 30+ conferences and seminars | Several scientific training programs.

The period from August 2013 to July 2018 reflects my role as a Research Lecturer at NCP, Islamabad, following the completion of MPhil in Physics, and before admission to PhD.

M.Phil. in Physics | **Riphah University, Islamabad, Pakistan.** (Aug 2010 – May 2013)

M.Sc. in Physics (16 Years) **|** Peshawar University, Pakistan. (Mar 2007 – Feb 2009)

(There was a brief gap of a few months while waiting for the next admission cycle, in which I attended a short course in computer software).

B.Sc. in Physics & Mathematics (14 Years): (Sep 2003 – Oct 2006)

(There was a six-month gap in this 2 years program following the devastating earthquake on October 8, 2005 in Pakistan, which completely damaged the infrastructure of my university in Muzaffarabad, AJK).

SSC and HSSC - Phy, Chem, Maths, Bio. (9-12 Years) (Mar 2000 – Jul 2003)

Professional Education | Bachelor of Education (B.Ed.) (Mar 2009 – July 2010)

Research Experience:

i. Postdoctoral Associate | New York University Abu Dhabi, UAE. (Oct. 2023 – Oct. 2025)
Research directions: Water-Energy nexus | Water treatment | Membranes| Nanosynthesis

Development of self-supported and conductive membrane electrodes with uniform architecture, low mass and minimal thickness for advanced electrochemical applications. Applications to Water-energy nexus technologies, including electrochemical capacitive energy harvesting systems such as capacitive mixing (CapMix) and capacitive deionization. Electrodeposition strategies and electrochemical resource recovery from brines, including selective ion extraction and metal recovery. **S**upported research activities through laboratory procurement, student mentoring, seminars, conferences, university activities, manuscript preparation and hands-on technical training. Using polymers like PVP and PTFE in membranes and electrodes for porosity modulation and as linkers.

ii. Postdoctoral Associate | GTIIT - Shantou, China (Jan. 2022 – Aug 2023)

Research lab establishment and procurement, Mentoring, and manuscript preparation etc.

iii. Research Lecturer | NCP Islamabad, Pakistan (Aug. 2013 – July 2018)

Provided teaching and mentoring support to undergraduate and graduate students through lectures, laboratory demonstrations, experiments, and research guidance. Assisted faculty with manuscript preparation, material characterization, seminars, and academic/administrative activities.

Summary of the Core Expertise:

Material Synthesis Routes:

Experienced in solution-gel, hydrothermal, and microwave/laser-assisted synthesis techniques for controlled morphology of nanocarbons and transition metal oxides (TMOs), including large-scale graphene oxide (GO) production using Hummers' method, preparation of nanoparticles, nanorods, and sheets, Membrane fabrication and chemical activation of GO using hydrazine.

Proficient in Conventional Thermal Annealing (CTA), vacuum annealing, inert gas annealing, and hands-on operation of autoclaves, sonicators, sintering systems, different ovens, centrifugal machines, and oil/water baths for advanced nanomaterial processing.

Hands-on Expertise in Electrochemical Techniques:

Proficient in operating electrochemical workstations and accessories, with expertise in CV, GCD, EIS, DPV, chronoamperometry, LSV, and other electrochemical characterization techniques.

Proficiency with Electrodes and devices:

Experienced in advanced electrochemical device fabrication and testing, including two and three-electrode setup, half-cell configurations, reference, glassy carbon, nickel foam, thin-film, and free-standing membrane electrodes; vacuum/pressure-assisted filtration-based carbon membrane fabrication, flow-cell capacitors, symmetric/asymmetric devices, water-flow systems, and 3D printing-based electrode design and development.

Characterization Techniques:

Well-versed in advanced material characterization techniques, including morphological and structural analysis using SEM, TEM, and HRTEM, along with spectroscopic characterization (Raman, FTIR, UV–Vis, XPS) and surface properties evaluation through BET and gravimetric techniques for surface area, porosity, and material analysis. Self-operation of SEM/TEM, XRD, Raman Spectroscopy, and BET/N2 absorption/desorption, Four-Probe equipment, PH meters, Conductivity meters, Mechanical strength measurement.

Language Skills: English: ITEP - 4.3/6 (equivalent to IELTS 7.0) **|** Chinese: One-year language course

List of Publications:

1. **Shafi, I.,** Nassrullah, H., & Hashaikeh, R. (2026). Enhanced Energy Extraction from Salinity and Temperature via Capacitive Mixing Technology. Electrochimica Acta, 149193.
   https://doi.org/10.1016/j.electacta.2026.149193 **Impact Factor = 5.6**
2. **Shafi, I.,** H. Nassrullah, and R. Hashaikeh. Self-standing porosity modulated carbon-based membrane electrodes for flexible pseudocapacitors, Energy Storage, 2024.
   https://doi.org/10.1016/j.est.2024.114085 **Impact Factor = 9.8**
3. **Shafi, I.,** Liang, E. and Li, B. Self-assembled $BiVO_4$ nanorods: Efficient electrode for nitrite sensors, J. Phys. Chem. Solids, 2022.
   https://doi.org/10.1016/j.jpcs.2021.110517 **Impact Factor = 4.**
4. **Shafi, I.,** Panagiotis, G., and Ishaq, A. Graphene Oxide-Based Fullerenes for Efficient Symmetric Configuration Supercapacitors, Energy Storage Technology. 2025.
5. https://doi.org/10.1002/est2.70179 **Impact Factor = 4**
6. **Shafi, I.,** Liang, E. and Li, B. Ultrafine chromium oxide (Cr_2O_3) nanoparticles as pseudocapacitive electrode materials for supercapacitors, J. Alloys Comp.,2021.
7. https://doi.org/10.1016/j.jallcom.2020.156046 **Impact Factor = 6.3**
8. **Shafi, I.,** Liang, E. and Li, B. Intercalation pseudocapacitive charge storage through d-spacing enlargement in recrystallized Cr_2O_3 nanostructures, Electro. Anal. Chem., 2022.
   https://doi.org/10.1016/j.jelechem.2022.116234 **Impact Factor = 4.1**
9. **Shafi, Imran,** et al. "Cr 2 O 3/rGO nanocomposite with excellent electrochemical capacitive properties." SN Applied Sciences 2 (2020): 1-10.
   10.1007/s42452-020-03636-8 **Impact Factor = 2.8**
10. Mumtaz, A., Iqbal, J., **Shafi, I.,** Oneeb, M., and Jabeen, S. Hafnium oxide-graphene electrodes for efficient aqueous supercapacitors, Diamond Relat. Mater., 2023.
    https://doi.org/10.1016/j.diamond.2023.110393 **Impact Factor = 5.1**
11. Maria Rania, Iqbal, J., **Shafi, I**. Graphene-Induced Enhanced Supercapacitor Properties of V_2O_5-GNPs Nanocomposites for Energy Storage Devices.
    10.21203/rs.3.rs-3900671/v1 **Impact Factor = 4.7**
12. Naz, Nazir A., et al. "Deep Levels in InGaN/GaN-LEDs." (2015).
    10.13189/mst.2015.030513 **Impact Factor = 5.4**
13. Mumtaz, Asifa, et al. "Electrolytic induced effects on hafnium oxide-based electrode material." Materials Today Communications 37 (2023): 107146.
    https://doi.org/10.1016/j.mtcomm.2023.107146 **Impact Factor = 4.5**
14. Engineering Hierarchically Porous Graphene Oxide/Carbon Nanoparticle Membrane Electrodes for Sustainable Heavy Metal Removal and Resource Recovery. **Materials Today IF=24**

Supervision Experience: Co-supervised 1 Ph.D. and 2 M.S. students at Quaid-e-Azam University, Islamabad, contributing to publications # 10-11.

Lab Trainings and Certifications: I have completed the following laboratory safety and technical trainings at NYUAD and the GTIIT. General Laboratory Safety, Chemical Safety, Hazardous Waste Handling and Disposal, Fire Safety/Fire Extinguisher Use, Emergency Response and Dealing Procedures (spills, injuries, evacuation, etc.), Radiation Safety, Laser Safety, Compressed Gas Cylinder Handling, Electrical Safety, Environmental Health and Safety (EHS) Orientation (seven modules), Lab-Specific Orientation and SOP Training, Fume Hood Safety and Operation. Most certifications can be provided upon request.

Conferences and Participation (Selected…)

Presenter, 2019 Annual Symposium on Nanomaterials for Energy Storage, Zhengzhou University, China.
Participant, 2020 International Forum on Electrochemical Applications, Zhengzhou University, China.
Presenter, 2021 Conference on Advanced Functional Materials, Zhengzhou University, China.

Oral Presenter, 2022 International Conference on Materials Science and Engineering (ICMSE), Shanghai, China.
Attendee, 2023 Electrochemical Energy Systems Symposium, Shenzhen, China.
Attendee, 2023 UAE Electrochemistry Symposium, Abu Dhabi, UAE.
Attendee, international Conference on Sustainable Materials and Electrochemical Applications, Sharjah, UAE.
Organizing member, IDEAS-2024, New York University Abu Dhabi.

Additional Research Expertise:

Working knowledge of ion-exchange membranes, including their selection, properties, transport mechanisms, and integration into electrochemical separation systems, water electrolyzers, fuel cells etc.

References:

Prof. Erjun Liang (PhD Supervisor) | Zhengzhou University	ejliang@zzu.edu.cn
Prof. Baojun Li (PhD Co-supervisor) | Zhengzhou University	lbjfcl@zzu.edu.cn
Prof. Ishaq Ahmad (MPhil Supervisor) | NCP Islamabad	ishaq.ahmad@ncp.edu.pk
Prof. Panagiotis Grammatikopoulos (Postdoc Mentor, GTIIT)	grammatikopoulos.g@uclm.es | g.panagiotisg@gmail.com

Availability: Immediately

Representative Research Contributions

Title: (The one I mention in cover letter)

Porous Graphene Oxide/Carbon Nanoparticle Membrane Electrodes for Simultaneous Removal and Recovery of Ni^{2+}, Cu^{2+}, and Zn^{2+} from Contaminated Water.

Materials Today, IF=24

Abstract

The increasing discharge of toxic heavy-metal ions into aquatic environments poses a serious threat to ecosystems and human health due to their persistence, bioaccumulation, and non-biodegradable nature. Conventional treatment methods often suffer from low adsorption capacity, poor selectivity, and limited reusability, particularly in complex wastewater containing multiple competing ions. In this study, a novel porous graphene oxide/carbon nanoparticle (GO/CNP) nanocomposite was successfully synthesized through graphene oxide preparation, carbon nanoparticle fabrication, nanocomposite assembly, and pore engineering to develop a highly porous and conductive adsorption platform. The novelty of this work lies in the development of a multifunctional GO/CNP nanocomposite capable of simultaneously removing and recovering Ni^{2+}, Cu^{2+}, and Zn^{2+} from competitive ternary aqueous systems while integrating comprehensive structural characterization, adsorption studies, regeneration, real wastewater validation, and ICP-OES quantification within a single platform. The synthesized nanocomposite was comprehensively characterized using SEM, TEM, XRD, Raman spectroscopy, FTIR, XPS, BET surface-area analysis, and elemental mapping, confirming the formation of a three-dimensional interconnected porous architecture with abundant oxygen-containing functional groups, high specific surface area, and uniformly distributed active adsorption sites. The adsorption performance was systematically evaluated through equilibrium isotherms, kinetic modeling, pH optimization, adsorbent dosage, selectivity studies, regeneration experiments, and real wastewater treatment. Under optimized conditions, the porous GO/CNP nanocomposite achieved a removal efficiency exceeding 95% and a maximum adsorption capacity of 134.2 mg g^{-1} for the simultaneous adsorption of Ni^{2+}, Cu^{2+}, and Zn^{2+}, significantly outperforming pristine GO and CNPs. The adsorption process followed the Langmuir isotherm and pseudo-second-order kinetic model, indicating monolayer chemisorption with rapid mass-transfer characteristics. The composite exhibited excellent selectivity in the presence of common coexisting ions and retained more than 85% of its initial adsorption efficiency after ten adsorption–desorption cycles, demonstrating remarkable structural stability and reusability. ICP-OES analysis further confirmed the substantial reduction of heavy-metal concentrations after treatment, validating the practical applicability of the developed adsorbent. The outstanding adsorption performance is attributed to the synergistic integration of graphene oxide sheets and conductive carbon nanoparticles, which provide enhanced surface area, abundant adsorption sites, hierarchical pore channels, and accelerated ion transport. These findings demonstrate that the porous GO/CNP nanocomposite is a highly efficient, reusable, and environmentally sustainable adsorbent for the simultaneous removal and recovery of multiple heavy-metal ions, offering considerable potential for advanced wastewater treatment and sustainable environmental remediation.

Keywords: Porous GO/CNP nanocomposite; Heavy metal adsorption; Simultaneous $Ni^{2+}/Cu^{2+}/Zn^{2+}$ removal; Wastewater treatment; Regeneration and recovery.

Previous Publications during PhD and Postdoc at NYUAD.

Publication 1

Title: *Self-standing Porosity Modulated Carbon-Based Membrane Electrodes for High Energy–Power Flexible Pseudocapacitors.* *Jol. of Energy Storage IF=9.8*

Lay Summary:

The growing demand for renewable energy and portable electronics requires energy storage devices that can charge rapidly, store more energy, and remain stable over long periods of operation. In this work, I developed advanced carbon-based electrodes for high-performance flexible pseudocapacitors, aiming to simultaneously improve both energy density and power density, two properties that are often difficult to optimize together.

A key innovation of this research was the fabrication of self-standing carbon membrane electrodes**,** eliminating the need for conventional metal current collectors and polymer binders that add inactive weight and reduce device performance. The electrodes were engineered with precisely controlled thickness, mass loading, dimensions, and pore structure, enabling systematic optimization of ion transport, electrical conductivity, and mechanical flexibility. This highly controllable and scalable fabrication strategy offers significant advantages for practical device manufacturing.

The resulting electrodes demonstrated enhanced electrochemical performance, excellent cycling stability, and mechanical flexibility, making them promising candidates for next-generation wearable electronics, portable energy storage systems, and flexible electronic devices. More broadly, this work provides a versatile platform for designing lightweight, binder-free functional materials that can be adapted for a wide range of electrochemical technologies, including batteries, sensors, and water-treatment systems.

Publication 2

Title:

Enhanced energy extraction from salinity and temperature gradients using self-standing carbon-based electrodes via CapMix technology. *Electrochemical Acta IF=5.6*

Lay Summary:

Large amounts of clean energy are naturally released when freshwater and seawater mix, yet efficiently capturing this energy remains a major scientific and engineering challenge. Capacitive mixing (CapMix) is a promising technology for harvesting this renewable "blue energy" without consuming fuel or producing any pollution. However, its practical implementation has been hindered by poor cyclic reversibility, electrode degradation, and limited long-term stability, restricting its commercial viability. In this work, I developed novel self-standing porous carbon membrane electrodes specifically designed to overcome these practical limitations. By eliminating conventional binders and current collectors while carefully engineering the electrode architecture and porosity, the new design significantly improved electrochemical reversibility, structural stability, and long-term cycling performance. To further bridge the gap between laboratory research and practical deployment, I also designed and demonstrated flow-cell capacitor devices based on fundamental electrochemical and fluid transport principles. These flow-based systems represent a practical device architecture for continuous energy harvesting and provide an important step toward the real-world implementation and scalability of capacitive mixing technologies.

Beyond improving blue-energy harvesting, this research introduced a new concept demonstrating that the same electrochemical principles can be applied to recover energy from industrial waste heat. Specifically, the study showed that low-grade hot water discharged from conventional thermal power plants, an abundant source of wasted energy, can be utilized to enhance electrochemical power generation. This work broadens the application of capacitive mixing beyond natural salinity gradients, opening new opportunities for sustainable energy recovery, improved industrial energy efficiency, and reduced environmental impact.

Publication 3 (Bio-sensing)

Title: *Electrochemical Sensor for Nitrite Detection in Drinking Water.* *J. Phys. Chem. Solids. IF=5.9*

Lay Summary:

Nitrite contamination in drinking water poses serious health risks, making rapid, accurate, and affordable detection essential for protecting public health. In this work, I developed a highly selective electrochemical sensor capable of detecting trace levels of nitrite with excellent sensitivity while minimizing interference from other ions and compounds commonly present in water. The sensor was fabricated using low-cost, readily available materials and a simple preparation method, making it suitable for economical and scalable production. Unlike conventional laboratory-based analytical methods that require expensive instrumentation and specialized personnel, this electrochemical sensing platform provides a rapid, portable, and cost-effective alternative for water quality monitoring. The combination of high selectivity, low detection limits, and inexpensive materials makes the technology particularly attractive for routine environmental monitoring, especially in resource-limited settings. This work demonstrates how advanced functional materials can be translated into practical technologies that improve water safety, protect public health, and enable accessible environmental monitoring.