MUHAMMAD ABDULLAH

Materials & Chemical Engineering Researcher

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RESEARCH PROFILE

Materials and chemical engineering researcher with experience in functional materials, surface engineering, superhydrophobic and anti-icing coatings, semiconductor materials, photocatalysis, thin films, and application-oriented materials development. Research portfolio includes peer-reviewed publications, patented technologies, hydrothermal and coating synthesis, photoelectrochemical materials, and structural/surface characterization. Experienced in collaborative multidisciplinary research spanning sustainable materials, water management, hydrogen production, and functional oxide systems.

RESEARCH EXPERTISE

Functional Materials • Surface Engineering • Superhydrophobic & Anti-Icing Coatings • Semiconductor Materials • Photocatalysis & Hydrogen Production • Thin Films • Nanomaterials • Sustainable Materials • Materials Characterization

RESEARCH EXPERIENCE

Research Assistant | Renewable Energy Laboratory, National Laboratory Astana, Kazakhstan Jan 2024 – Present

- Conduct research on superhydrophobic and anti-icing materials for asphalt/concrete and other application-oriented surfaces, with emphasis on wettability, durability, and practical performance.
- Contribute to synthesis and optimization of functional semiconductor materials, including zinc oxysulfides and oxide-based thin-film systems for photocatalytic and photoelectrochemical applications.
- Support materials development through experimental design, synthesis, characterization, data interpretation, scientific writing, and preparation of patentable research outputs.
- Collaborate on multidisciplinary studies in sustainable water management, oil–water separation, porous silicon, functional coatings, and emerging energy materials.

Research Assistant | Nazarbayev University, Kazakhstan Nov 2022 – Nov 2023

- Contributed to a funded research project on centrifugal additive manufacturing of fine-powder composites under the supervision of Prof. Boris Golman.
- Worked with powder-processing concepts, non-spherical particle systems, computational tools, and analysis of powder flow behavior.

EDUCATION

M.S. in Chemical and Materials Engineering 2022 – 2024

Nazarbayev University, Astana, Kazakhstan

Thesis: Analysis of Dynamic Flow Properties of Powder Mixture with Non-spherical Particles

B.S. in Chemical Engineering 2017 – 2021

NFC Institute of Engineering and Technology, Multan, Pakistan

Thesis: Production of Diesel from Waste Plastic

PATENTS & INTELLECTUAL PROPERTY

- Method for Producing a Composite Photocatalytic Film Based on a Combination of Gold and Gallium Zinc Oxides — Utility Model Patent No. 12463, Kazakhstan (2026).
- Method for Producing Composite Thin Films for Photoelectrochemical Water Splitting — Utility Model Patent No. 11017, Kazakhstan (2025).
- Method of Preparation of High-Performance Oxide Thin-Film Coatings Based on InGaZnO — Utility Model Patent No. 10726, Kazakhstan (2025).
- Method of Hydrothermal Production of Zinc Oxysulfides with Controlled Properties — Utility Model Patent No. 10716, Kazakhstan (2025).
- Method of Production of Superhydrophobic Quartz Sand — Utility Model Patent No. 10437, Kazakhstan (2025).

PEER-REVIEWED PUBLICATIONS

1. Muhammad Abdullah, Mergen Zhazitov, Nazerke Kydyrbay, Tolagay Duisebayev, Yerbolat Tezekbay, Olzat Toktarbaiuly. “Stearic-Acid-Coated Sand: A Game Changer for Agricultural Water Management.” Nanomaterials, 15(10), 721 (2025).
2. Mergen Zhazitov, Muhammad Abdullah, Nazerke Kydyrbay, Enoch Adotey, Zhexenbek Toktarbay, Tolagay Duisebaev, Yerbolat Tezekbay, Nurxat Nuraje, Olzat Toktarbaiuly. “Fabrication of Mechanically Resistant ZnO-based Superhydrophobic Material for Enhanced Concrete Applications.” Case Studies in Construction

Materials (2025).

3. Nazerke Kydyrbay, Mergen Zhazitov, Muhammad Abdullah, et al. “Structural, Surface, and Theoretical Investigation of Hydrophobic-Modified Nanodiamond Powders.” Scientific Reports, 15, 24329 (2025).
4. Tolagay Duisebayev, Muhammad Abdullah, Yerbolat Tezekbay, Mergen Zhazitov, Nazerke Kydyrbay, Nurxat Nuraje, Olzat Toktarbaiuly. “Hydrothermal Synthesis and Photocatalytic Performance of Zinc Oxysulfide for Hydrogen Evolution.” Engineered Science (2025).
5. Nazerke Kydyrbay, Mergen Zhazitov, Muhammad Abdullah, Yerbolat Tezekbay, Tolagay Duisebayev, Nurxat Nuraje, Olzat Toktarbaiuly. “Superhydrophobic and Anti-Icing Coatings on Asphalt Pavements: A Review.” ACS Omega (2025).
6. N. Kydyrbay, M. Zhazitov, M. Abdullah, et al. “Utilization of SiO2 Nanoparticles in Developing Superhydrophobic Coatings for Road Construction: A Short Review.” Molecules, 30(13), 2705 (2025).
7. Alshyn Abduvalov, Yerbolat Tezekbay, Toreniyaz Shomenov, Tolagay Duisebayev, Mergen Zhazitov, Nazerke Kydyrbay, Muhammad Abdullah, et al. “Experimental Plasmon-Induced Photocatalytic Enhancement of ZnO-Ga2O3 Composite Thin Films and First-Principle DFT Calculations.” Applied Surface Science (2026).
8. Alisher Skabylov, Lazzat Abdizhalilova, Margulan Ibraimov, Bakyt Khaniyev, Yerbolat Tezekbay, Muhammad Abdullah, et al. “Wireless Ammonia Gas Sensor Based on P-type Porous Si: Methods, Materials and Design.” Engineered Science (2025).
9. Olzat Toktarbaiuly, Mergen Zhazitov, Muhammad Abdullah, et al. “In Situ Optical Monitoring and Morphological Evolution of Si Nanowires Grown on Faceted Al2O3(0001) Substrates.” Nanomaterials, 15(20), 1589 (2025).
10. Y. Tezekbay, M. Zhazitov, N. Kydyrbay, M. Abdullah, et al. “Indium Gallium Zinc Oxide Thin Films as Emerging Photoelectrode Materials for Efficient Solar Water Splitting.” ES Energy & Environment, 30, 1823 (2025).
11. T. Duisebayev, M. Zhazitov, M. Abdullah, et al. “Anisotropic Resistive Switching in NiO Thin Films Deposited on Stepped MgO Substrates.” Nanomaterials, 15(22), 1703 (2025).
12. O. Toktarbaiuly, M. Zhazitov, N. Kydyrbay, T. Duisebayev, Y. Tezekbay, N. Nuraje, M. Abdullah, H. Idriss. “Oxy-Sulfide Semiconductors for Hydrogen Production from Pure Water: Materials Design, Performance, and Stability.” Journal of Materials Chemistry A, 14(36), 23578–23597 (2026).
13. Y. Sagidolda, K. Tuokedaerhan, R. Azamat, M. Darmenkulova, S. Zhumatova, M. Ibraimov, Y. Tezekbay, M. Zhazitov, M. Abdullah, B. Akilbekov, et al. “The Effect of Ti, W, Ag and TiO2 Particles on the Structural and Optical Properties of Porous Silicon Obtained in Various Electrolytes.” Scientific Reports (2026).
14. M. Zhazitov, M. Abdullah, B. Akilbekov, et al. “Development of a Hybrid Material: Superhydrophobic Nanoparticles in Paraffin Matrices for Water-Repellent Applications.” Journal of Engineering and Environmental Systems, 1(1), 42–56 (2026).
15. M. Zhazitov, A. Ardakkyzy, Y. Tileuberdi, N. Kydyrbay, M. Huang, M. Abdullah, et al. “Waste-Derived Carbon-Coated Coked Sand for Efficient Gravity-Driven Oil–Water Separation.” Chemical Engineering Journal: Green and Sustainable, 100101 (2026).

TECHNICAL EXPERTISE

• **Materials synthesis & processing:**
Hydrothermal synthesis; solution-based materials preparation; calcination/thermal treatment; surface functionalization; superhydrophobic coating development; thin-film and composite-material research.

• **Characterization:**
X-ray diffraction (XRD); scanning electron microscopy (SEM); transmission electron microscopy (TEM, training); Raman spectroscopy; FTIR spectroscopy; wettability/contact-angle analysis; materials morphology and structure–property interpretation.

• **Modeling & computation:**
COMSOL Multiphysics; DEM/LIGGGHTS; Aspherix GUI; Python for scientific data processing and analysis.

• **Research practice:**
Experimental design; scientific literature analysis; technical reporting; manuscript preparation; patent-oriented research documentation; multidisciplinary collaboration.

SELECTED TRAINING & SCIENTIFIC PRESENTATIONS

MatRIX — Materials Training in Research & Innovation Exchange | INMET, Nazarbayev University Jul 2026
- Two-week intensive research training covering SEM, TEM, XRD, Raman, FTIR, data analysis, mini-project work, scientific writing, research ethics, and participation in the INESS scientific conference.

Speaker | 4th International Symposium on Emerging Materials and Devices | Nazarbayev University May 2025
- Presented “Stearic Acid-Coated Sand (SACS): A Superhydrophobic Material for Sustainable Water Management in Agriculture.”

ADDITIONAL PROFESSIONAL EXPERIENCE

Plant Supervisor | 3A Apparels, Lahore, Pakistan Oct 2021 – May 2022
- Managed denim-washing operations, production quality, technical documentation, and resource-efficient water/chemical use.

Service Engineer | Faisalabad, Pakistan Aug 2021 – Oct 2021

- Installed, commissioned, troubleshot, and maintained reverse-osmosis plants and industrial steam boilers.

LEADERSHIP

- Founding President, Nazarbayev University Adventure Club (Aug 2022 – Present) — established and led a university community for organized outdoor and adventure activities.
- Sports Organizer, NFC IET Multan (Feb 2020) — coordinated sports-week scheduling, logistics, and budget management.

REFERENCES

Prof. Boris Golman
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Prof. Yanwei Wang
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Dr. Muhammad Usman Rashid
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