

SHAHADAT HUSSAIN, PhD

MATERIALS RESEARCHER | ADDITIVE MANUFACTURING | METAMATERIALS & SHAPE MEMORY ALLOYS

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PROFILE SUMMARY

Materials engineer and additive manufacturing researcher with over a decade of experience spanning institutions in India and the United Arab Emirates, currently a Research Associate in the Division of Engineering at New York University Abu Dhabi. Research centers on the design, fabrication, and characterization of architected metamaterial structures, including triply periodic minimal surface (TPMS) lattices, interpenetrating phase composites (IPCs), and shape memory alloy systems (NiTi and Cu-based), employing fused filament fabrication (FFF), stereolithography (SLA), laser powder bed fusion (LPBF), and hybrid casting routes. Author of 16+ peer-reviewed journal articles, conference proceedings, and a book chapter, with over 500 citations and an h-index of 10. Active peer reviewer for over 15 international journals including Additive Manufacturing, Scripta Materialia, and the International Journal of Mechanical Sciences. Holds a PhD in Materials Science and Technology from the Academy of Scientific and Innovative Research (AcSIR), CSIR-AMPRI, India, and brings combined expertise in experimental materials characterization, mechanical testing, and data science/machine learning methods applied to materials research problems.

RESEARCH INTERESTS

- Additive manufacturing of metamaterials: FFF, SLA, LPBF, and hybrid manufacturing routes
- Triply periodic minimal surface (TPMS) lattice structures — primitive and gyroid topologies
- Interpenetrating phase composites (IPCs) for structural strength and vibration damping
- NiTi and Cu-based shape memory alloys — phase transformation behavior and microstructure
- Fiber-reinforced polymer composites and process-structure-property relationships
- Hybrid manufacturing: AM sacrificial patterns for metal casting (aluminum TPMS structures)
- Green/sustainable additive manufacturing — stainless steel-reinforced polymer filaments for heavy structural components

EDUCATION

Doctor of Philosophy (PhD), Materials Science and Technology

Aug 2014 – Jul 2019

Academy of Scientific and Innovative Research (AcSIR), CSIR–Advanced Materials and Processes Research Institute (AMPRI), Bhopal, India

- Doctoral thesis: Investigation of the impact of grain refiners, alloying additions, and processing parameters on the behavior and shape memory properties of Cu-Al-Ni shape memory alloys for high-temperature applications.
- Research encompassed alloy synthesis via vacuum induction melting, heat treatment, quenching, hot rolling, metallography, and mechanical/functional characterization including tensile, compression, and hardness testing at varying temperatures, with shape recovery evaluation via improved testing methodologies.
- PhD coursework: Materials Science and Engineering; Scientific Ethics, Technical Communications and Safety; Characterization and Analytical Techniques; Heat Treatment; Tribology; Phase Transformation; Lightweight Materials; Powder Metallurgy; Composite Science and Engineering; Nano Science and Engineering; Materials Synthesis and Processing; Computer Simulation and Design; Functional and Smart Materials; Cellular Materials.

Bachelor of Engineering (BEng), Mechanical Engineering

Aug 2008 – Jun 2012

University Institute of Technology (UIT), Rajiv Gandhi Proudyogiki Vishwavidyalaya (RGPV), Bhopal, India

- Completed a two-week industrial internship at Bokaro Steel Plant, Steel Authority of India, during third year.
- Major project on biomass gasification as an alternative energy source for internal combustion engines and turbomachines; coursework spanned machine component design, thermal sciences, IC engines, fluid and turbomachinery, production and industrial engineering, and operations management.

ACADEMIC & PROFESSIONAL EXPERIENCE

Research Associate — Division of Engineering

Sep 2024 – Present

New York University Abu Dhabi (NYUAD), Abu Dhabi, UAE

- ▶ Developed Fused Filament Fabrication (FFF) processes for carbon- and glass-fiber-reinforced polymer composites (PPA, PLA, ABS, Verowhite, Nylon) using a Raise3D Pro3 Plus HS printer.
- ▶ Scaled large-format TPMS beams through hybrid SLA-pattern and sand/clay casting techniques.
- ▶ Fabricated interpenetrating phase composites (IPCs) with TPMS architectures using multiple resin systems to enhance structural strength and vibration-damping performance.
- ▶ Performed four-point bending tests on IPC and non-IPC beams to evaluate flexural strength, rigidity, deflection, and stress distribution; conducted compression testing on TPMS cubes to analyze elastic modulus, yielding behavior, plateau region, densification, toughness, resilience, and energy absorption.

Postdoctoral Fellow — Mechanical Engineering

Feb 2020 – Jun 2024

Khalifa University, Abu Dhabi, UAE

- ▶ Characterized additively manufactured NiTi triply periodic minimal surface (TPMS) structures — Schwarz primitive and Schoen gyroid lattices — as a class of porous, cellular, architected materials.
- ▶ Performed tensile and fatigue testing on thin NiTi wires of varying diameter, chemical composition, and surface treatment (etched, mechanically polished, etched-polished, light oxide coating) using an Instron 8872 fatigue testing machine.
- ▶ Conducted chemical etching of NiTi samples using hydrofluoric and nitric acids under controlled lab safety protocols.
- ▶ Applied a broad analytical suite including optical microscopy, SEM, XRD, EDS, metallography, heat treatment, EBSD, and AFM for materials investigation; proficient in Xpert HighScore Plus, ImageJ, Origin, Gatan suite, FreeCAD, Python, and LaTeX.
- ▶ Completed comprehensive EHS lab safety training covering ergonomics, emergency response, waste management, chemical safety, fire safety, risk assessment, electrical/radiation safety, cryogenic substances, ventilation, and PPE.

Project Fellow — Department of Smart and Functional Materials

Jun 2013 – Aug 2014

CSIR – Advanced Materials and Processes Research Institute (AMPRI), Bhopal, India

- ▶ Contributed to the Government of India (12th Five Year Plan)-sponsored project 'Design and Development of Thermo-responsive and Magnetic Shape Memory Materials and Devices for Engineering Applications,' funded by the Council of Scientific and Industrial Research.
- ▶ Synthesized Cu-Al-Mn and Cu-Al-Ni shape memory alloys via vacuum induction melting; performed standard metallography, heat treatment, and hot rolling.
- ▶ Characterized materials using optical emission spectroscopy, optical microscopy, SEM, XRD, DSC, hardness testing, and tensile testing.
- ▶ Outcomes contributed to 5 peer-reviewed SCI journal publications, poster and oral presentations, and a research collaboration with the Department of Metallurgical and Materials Engineering, IIT Madras.

Lecturer — Mechanical Engineering

Sep 2012 – May 2013

Oriental Group of Institutions, Bhopal, India

- ▶ Taught mechanical engineering subjects to first-, second-, and third-year undergraduates, including materials science, machine component design, and strength and mechanics of materials; facilitated laboratory sessions.
- ▶ Completed a two-week ISTE workshop on Engineering Thermodynamics organized by IIT Bombay, covering classification techniques, numerical problem-solving strategies, and technical presentation methods.

Engineering Intern

Jun 2011 – Jul 2011

Bokaro Steel Plant, Steel Authority of India Limited (SAIL), Jharkhand, India

- ▶ Completed a two-week industrial training program across Coke Ovens, Blast Furnace, Machine Shops, Foundry Shop, Steel Melting Shop, Continuous Casting Shop, Hot Rolling Mill, and Cold Rolling Mill.

JOURNAL PUBLICATIONS

- ▶ Singh A, Hussain S, Song Q, Moustafa MA, Karathanasopoulos N. *Statics and Dynamics of Architected TPMS Metallic Beam Structures: Experiments and Modeling*. 2026 Thin-Walled Structures. DOI: 10.1016/j.tws.2026.115364
- ▶ Hussain S, Mehraj H, Karathanasopoulos N, Moustafa MA. *Do Chopped Fibers Matter? Process-Structure-Property Relationships and Thermal Annealing Effects in Fiber-Reinforced TPMS Lattices*. 2026 Progress in Additive Manufacturing. DOI: 10.1007/s40964-026-01791-9
- ▶ Hussain S, Alagha AN, Zaki W. *Phase Transformation Behavior of NiTi Triply Periodic Minimal Surface Lattices Fabricated by Laser Powder Bed Fusion*. 2024 Journal of Materials Engineering and Performance. DOI: 10.1007/s11665-024-09162-7
- ▶ Hussain S, Alagha AN, Haidemenopoulos GN, Zaki W. *Microstructural and Surface Analysis of NiTi TPMS Lattice Sections Fabricated by Laser Powder Bed Fusion*. 2023 Journal of Manufacturing Processes, 102:375–386. DOI: 10.1016/j.jmapro.2023.07.055
- ▶ Hussain S, Alagha AN, Zaki W. *Imperfections Formation in Thin Layers of NiTi Triply Periodic Minimal Surface Lattices Fabricated Using Laser Powder Bed Fusion*. 2022 Materials, 15(22):7950. DOI: 10.3390/ma15227950
- ▶ Alagha AN, Hussain S, Zaki W. *Additive Manufacturing of Shape Memory Alloys: A Review with Emphasis on Powder Bed Systems*. 2021 Materials & Design, 204:109654. DOI: 10.1016/j.matdes.2021.109654
- ▶ Hussain S, Pandey A, Dasgupta R. *Nano-CeO₂ Doped Cu-Al-Ni SMAs with Enhanced Mechanical as well as Shape Recovery Characteristics*. 2021 Metals and Materials International, 27:1478–1482. DOI: 10.1007/s12540-019-00570-2
- ▶ Pandey A, Hussain S, Nair P, Dasgupta R. *Influence of Niobium and Silver on Mechanical Properties and Shape Memory Behavior of Cu-12Al-4Mn Alloys*. 2020 Journal of Alloys and Compounds. DOI: 10.1016/j.jallcom.2020.155266
- ▶ Dasgupta R, Pandey A, Hussain S, Jain AK, Ansari A, Sampath V. *Effect of Microstructure on Roll-Ability and Shape Memory Effect in Cu-Based Shape Memory Alloys*. 2019 Applied Innovative Research, 1:29–37.
- ▶ Hussain S, Pandey A, Dasgupta R. *Designed Polycrystalline Ultra-High Ductile Boron Doped Cu-Al-Ni Based Shape Memory Alloy*. 2019 Materials Letters, 240:157–160. DOI: 10.1016/j.matlet.2018.12
- ▶ Pandey A, Jain AK, Hussain S, Sampath V, Dasgupta R. *Effect of Nano CeO₂ Addition on the Microstructure and Properties of a Cu-Al-Ni Shape Memory Alloy*. 2016 Metallurgical and Materials Transactions B, 47:2205–2210. DOI: 10.1007/s11663-016-0691-0
- ▶ Jain AK, Hussain S, Kumar P, Pandey A, Dasgupta R. *Effect of Varying Al/Mn Ratio on Phase Transformation in Cu–Al–Mn Shape Memory Alloys*. 2015 Transactions of the Indian Institute of Metals, 69:1289–1295. DOI: 10.1007/s12666-015-0689-3
- ▶ Hussain S, Kumar P, Jain AK, Pandey A, Dasgupta R. *Effects of Different Quaternary Additions in the Properties of a Cu-Al-Mn Shape Memory Alloy*. 2015 Materials Performance and Characterization, 4:225–235. DOI: 10.1520/MPC20150017
- ▶ Kumar P, Jain AK, Hussain S, Pandey A, Dasgupta R. *Changes in the Properties of Cu-Al-Mn Shape Memory Alloy due to Quaternary Addition of Different Elements*. 2015 Revista Materia, 20:284–292. DOI: 10.1590/S1517-707620150001.0028
- ▶ Dasgupta R, Jain AK, Kumar P, Hussain S, Pandey A. *Role of Alloying Additions on the Properties of Cu–Al–Mn Shape Memory Alloys*. 2015 Journal of Alloys and Compounds, 620:60–66. DOI: 10.1016/j.jallcom.2014.09.047
- ▶ Dasgupta R, Jain AK, Kumar P, Hussain S, Pandey A. *Effect of Alloying Constituents on the Martensitic Phase Formation in Some Cu-Based SMAs*. 2014 Journal of Materials Research and Technology, 3:264–273. DOI: 10.1016/j.jmrt.2014.06.004

BOOK CHAPTER

- ▶ Dasgupta R, Jain AK, Hussain S, Pandey A, Sampath V. *Effect of Alloying Additions on the Properties Affecting Shape Memory Properties of Cu–12.5Al–5Mn Alloy*. 2018 In: Muruganant M., Chirazi A., Raj B. (eds) Frontiers in Materials Processing, Applications, Research and Technology, Springer, Singapore. DOI: 10.1007/978-981-10-4819-7_33

CONFERENCE PROCEEDINGS

- ▶ Hussain S, Alagha AN, Zaki W. *Inhomogeneous Microstructure due to Non-Uniform Solidification Rate in NiTi Triply Periodic Minimal Surface (TPMS) Structures Fabricated via Laser Powder Bed Fusion*. 2022 ASME International Mechanical Engineering Congress and Exposition (IMECE 2022), Columbus, Ohio, USA. DOI: 10.1115/IMECE2022-95320

- ▶ Hussain S, Jain AK, Ansari MA, Pandey A, Dasgupta R. *Study of Effect of Fe, Cr and Ti on the Martensite Phase Formation in Cu-12.5wt%Al-5wt%Mn SMA*. 2017 Advanced Materials Proceedings, 2(1):22–25. DOI: 10.5185/amp.2017/106

ORAL & POSTER PRESENTATIONS

Oral Presentations

- ▶ The Best Practices in Teaching and Learning Conference, Khalifa University, Abu Dhabi, May 2023 (Organized by Khalifa University, American University of Sharjah, and Amity University Dubai)
- ▶ Inhomogeneous Microstructure due to Non-Uniform Solidification Rate in NiTi TPMS Structures — ASME IMECE 2022, Columbus, Ohio, USA, November 2022
- ▶ Improvement in Shape Memory Properties of CuAlNiZn Shape Memory Alloys due to Addition of Grain Refiners — National Seminar on Advances in Smart & Functional Materials, CSIR-AMPRI, Bhopal, January 2017
- ▶ Study of Effect of Fe, Cr and Ti on the Martensite Phase Formation in Cu-12.5wt%Al-5wt%Mn SMA — International Conference on Materials Science and Technology, University of Delhi, March 2016 (Organized by IAAM, VBRI Press, and University of Delhi)

Poster Presentations

- ▶ Microstructural Changes and Effect on Mechanical and Shape Memory Properties in a CuAlNi Alloy on Addition of Dispersoid — RIAM-2018, CSIR-AMPRI, Bhopal, September 2018
- ▶ Changes in Properties due to Alloying Addition of Mn and Cr to Cu-Al-Ni-Zn Shape Memory Alloys — India International Science Festival (IISF-2016), CSIR-NPL, New Delhi, December 2016
- ▶ Effect of Addition of Alloying Element Chromium to Cu-Al-Ni-Zn Shape Memory Alloys — 70th IIM NMD-ATM Conference, IIT Kanpur, November 2016
- ▶ Role of Grain Refiners for Improved Shape Memory Properties of Cu-12.5wt%Al-5wt%Mn Shape Memory Alloy — National Seminar on Recent Innovations in Advanced Materials, CSIR-AMPRI, Bhopal, December 2015

TECHNICAL SKILLS & EQUIPMENT

Additive Manufacturing Systems: EOS M400 (LPBF/SLM); Raise3D Pro3 Plus HS, Pro2 Plus, Forge1 (FFF); Stratasys F370/J850 (FDM/PolyJet); Formlabs Form3 (SLA); Bambu Lab Carbon X1; Ultimaker S1

Materials Characterization: JEOL 7610F SEM; FEI Nova NanoSEM; FEI Quanta 3D FIB-SEM (SEI/BSE/EDS); Bruker D2 & Rigaku MiniFlex XRD; Mettler Toledo DSC1; Setaram DSC; Leica optical microscopy; Bruker Q4 Tasman; EBSD; AFM

Mechanical Testing & Processing: Instron 5969 (static, 50 kN); Instron 8872 (fatigue, 25 kN); MTS 100 kN UTM; Controls Simplex 350 & Automax; KB 250 BVRZ hardness tester; vacuum induction melting; hot/cold rolling; heat treatment; metallography; chemical etching (HF/nitric acid)

Design, Simulation & CAD: FreeCAD; Tinkercad; MSLattice; Materialise Magics; GrabCAD Print; Bambu Studio; PreForm; IdeaMaker; Cura

Data Science & Programming: Python (Pandas, NumPy, Scikit-learn, Matplotlib, Plotly, Seaborn, SciPy); MATLAB; SQL/SQLite; Jupyter Notebook; Linux; Shell scripting; LaTeX

Analysis Software: Xpert HighScore Plus; ImageJ; Origin; Gatan microscope image analysis suite

CERTIFICATIONS & PROFESSIONAL DEVELOPMENT

- ▶ IBM Data Science Professional Certificate — IBM
- ▶ Google AI Essentials Certificate — Google
- ▶ Python for Everybody Specialization — University of Michigan
- ▶ Image Processing for Science and Engineering — MathWorks
- ▶ Responsible Conduct of Research (RCR) — CITI Program, Florida, USA (2020): research misconduct, data management, conflict of interest, collaborative research, authorship, plagiarism, research involving human subjects
- ▶ Teaching Certificate Course — Center for Teaching and Learning, Khalifa University (2023): effective teaching strategies, assessment techniques, ethics and professionalism, educational technology, active learning, classroom dynamics, intercultural communication, micro-teaching

- Lab Safety (EHS) Certification — Khalifa University (2021): ergonomics, emergency response, waste management, chemical/fire/electrical/radiation safety, cryogenic substances, hydrofluoric acid handling

TEACHING EXPERIENCE & INTERESTS

Lecturer, Mechanical Engineering, Oriental Group of Institutions (2012–2013): instructed first-, second-, and third-year undergraduates in materials science, machine component design, and strength and mechanics of materials.

Teaching Interests: Engineering Materials; Mechanics of Materials; Manufacturing Processes; Engineering Thermodynamics

PEER REVIEW & PROFESSIONAL SERVICE

Active peer reviewer for 15 international journals, including:

- Additive Manufacturing; Materials Characterization; Journal of Materials Science and Technology; Journal of Manufacturing Processes
- Advances in Industrial and Manufacturing Engineering; International Journal of Mechanical Sciences; Journal of the Mechanical Behavior of Biomedical Materials
- Materials & Design; Materials Letters; Materials Science and Engineering A; Materials Today Communications
- Scripta Materialia; Thin-Walled Structures; Intermetallics; Journal of Materials Science: Materials in Engineering

PROFESSIONAL AFFILIATIONS

- Advisory Board Member, Encyclopedia (MDPI) — Engineering Section
- Individual Member, Research Data Alliance (RDA)
- Associate Member, European Materials Modelling Council (EMMC)
- Member, AM-Platform: European Technology Platform in Additive Manufacturing

ADDITIONAL INFORMATION

Languages: English (Professional), Hindi (Native)

Profiles: Google Scholar: scholar.google.com/citations?user=tQNSWaAAAAAJ | ResearchGate: researchgate.net/profile/Shahadat-Hussain