Kashif Nawaz

Dr. Nawaz is a researcher in fundamental and applied energy conversation science and technology. He is widely recognized for his work in different aspects of building heating, cooling, and dehumidification systems including novel heat exchanger, enhanced phase change processes through the deployment of additive manufacturing, porous media and surface morphology, heat pump air and water heating, efficient separate sensible and latent cooling systems and emerging refrigerants. He has pioneered the development of a new generation of high-temperature heat exchanger manufactured with ceramics and composites using additive manufacturing. More recently, his research has led to the development of unique concepts for direct air capture of carbon dioxide using existing building infrastructure.

Research Expertise

- Heat and mass transfer at macro/micro and meso scale.
- Transport phenomena in porous media.
- Two-phase flow: experimental/analytical techniques.
- Advanced energy storage materials, equipment and systems.
- Novel heat exchanger designs for HVAC&R applications.
- Low global warming potential refrigerants, life cycle climate performance modeling.
- Solid and liquid desiccants.

Education

- Ph.D., Mechanical Engineering, 2013, University of Illinois at Urbana Champaign
- M.S., Mechanical Engineering, 2010, University of Illinois at Urbana Champaign.
- BS, Mechanical Engineering, 2007, Ghulam Ishaq Khan Institute of Science and Technology, Pakistan

Employment History

- Distinguished Research Staff and Section Head, Building Technologies Research, Oak Ridge National Laboratory, Oak Ridge, TN (12/22–present)
- Sub-Program Manager, Cross-sector Technologies for Decarbonization, Oak Ridge National Laboratory, Oak Ridge, TN (01/21–present)
- Research Scientist, Building Equipment Research, Oak Ridge National Laboratory, Oak Ridge, TN (8/16–10/20)
- Senior Heat Transfer Engineer, Heat Transfer Center of Excellence, Johnson Controls Inc. Norman, OK (9/13–7/16)
- Lecturer and Research Staff, Aerospace and Mechanical Engineering, University of Oklahoma, Norman, OK (1/14–7/16)
- Graduate Research Assistant, Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, Urbana, IL (8/08–8/13)

Honors and Awards

- ASHRAE Crosby Field Award (2023)
- Knox.biz 40 under 40 Award (2023)
- R&D 100 Award “Ultraclean Condensing Gas Furnace” (2022)
- ASHRAE Exceptional Service Award (2022)
- ORNL Innovation Award (2021)
- R&D 100 Award “BIG-NET: Bis-iminoguanidine Negative Emission Technology” (2021)
- ASHRAE Distinguished Service Award (2018)
- Johnson Controls Inc. Merit Award for Excellence in Research and Innovation (2015)
- ASHRAE Graduate Student Grant-in-Aid Award (2011)
- University of Illinois at Urbana Champaign Alumni Teaching Fellowship (2011 and 2012)

Selected Journal Publications

1. J. Rendall, A. Elatar, K. Nawaz, J. Sun “Medium-temperature phase change material integration in domestic heat pump water heaters for improved thermal energy storage”, Renewable and Sustainable Energy Reviews 185, 113656.
2. Bola Yoon, Dylan Richardson, Saad A Jajja, Corson L Cramer, Michael J Lance, Kashif Nawaz, Edgar Lara-Curzio, “Environmental stability of additively manufactured siliconized silicon carbide for applications in hybrid energy systems”, Journal of the American Ceramic Society, 2023,106, 10, 6141-6151.
3. F. D. F. Chuahy, K. Kincaid, K. Nawaz “A thin-film modeling approach for analysis of carbon capture sorbent-based devices” Carbon Capture Science & Technology, 2023/8/9.

4. P. Wang, A. Abu-Heiba, R. H. Mohammed, J. Spitzenberger, S. Kowalski, H. Ma, K. Nawaz, “Thermodynamic Analysis of a Two-Stage Binary-Fluid Ejector Heat Pump Water Heater” Thermal Science and Engineering Progress, 2023, 102050
5. K. Li, T. Smith, W. Asher, A. Flores-Betancourt, A. A. Trofimov, H. Wang, M. Zhang, L. Kearney, E. Lara-Curzio, S. Ozcan, V. Kunc, A. K. N. and K. Nawaz, “Additively manufactured polymer composites for heat exchanger applications: evaluation of critical thermophysical properties” Journal of Materials Science, 58, 11585–11596.
6. J. Sun, K. Nawaz, J. Rendall, A. Elatar, J. Brechtl “Heat pump water heater enhanced with phase change materials thermal energy storage: Modeling study”, International Communications in Heat and Mass Transfer, 146, July 2023, 106917
7. Z. Gao, K. Rice, K. Nawaz, “Modelado y simulación de un calentador de agua con bomba de calor de CO2 alimentado por aire” Frio Calor Aire Acondicionado, 2023.
8. R. J. Lane, M. S. Kesler, K. Nawaz, R. Mirzaeifar, “Investigating the failure behavior of cast Al-11Ce-0.4Mg alloys using in-situ scanning electron microscopy tensile testing” Journal of Alloys and Compounds, 947, 25 June 2023, 169491.
9. J. K. Mendizábal, B. P. Singh, K. F. Rabbi, N. V. Upot, K. Nawaz, A. Jacobi, N. Miljkovic, “Enhanced internal condensation of R1233zd (E) on micro-and nanostructured copper and aluminum surfaces,” International Journal of Heat and Mass Transfer, 207, 2023, 124012
10. A. Arshad, S. A. Iqrar, S. C. C. Pereira, M. W. Shahzad, K. Nawaz, W. Worek, “Cooling performance of an active-passive hybrid composite phase change material (HcPCM) finned heat sink: Constant operating mode”, International Journal of Heat and Mass Transfer, 207, 15 June 2023, 123973
11. J. Rendall, J. Brechtl, K. Nawaz, A. Elatar, J. Sun, K. An, X. Liu, W. Asher, “Experimental results of embedded phase change material capsules for increasing the performance of a wrapped heat pump water heater,” International Communications in Heat and Mass Transfer, 145, Part A, 2023, 106806
12. M. Muneeshwaran, C. Yang, K. Nawaz, C. C. Wang, “Understanding airflow pattern and temperature distribution in domestic refrigerators–A review analyzing recent developments and bridging knowledge gaps,” Sustainable Energy Technologies and Assessments, 57, June 2023, 103171
13. J. D. Rendall, A. Abu-Heiba, K. R. Gluesenkamp, K. Nawaz, W. Worek, Nondimensional convection numbers modeling thermally stratified storage tanks: Richardson's number and hot-water tanks, Renewable and Sustainable Energy Reviews, 2021, 150, 111471
14. H. Jin, S. Shahane, Y. Zhang, X. Wang, K. Nawaz, Modeling of crystallization fouling on a horizontal-tube falling-film evaporator for thermal desalination, International Journal of Heat and Mass Transfer, 2021, 178, 121596
15. J. Spitzenberger, P. Wang, L. Ismael, H. Ma, A. Abuheiba, K. Nawaz, Theoretical Analysis of a Single-Stage Gas-Fired Ejector Heat Pump Water Heater, Journal of Thermal Science and Engineering Applications, 2021, 14, 4, 041009
16. M. Mousa, A. Gunay, D. Orejon, K. Nawaz, N. Miljkovic, Gas-Phase Temperature Mapping of Evaporating Microdroplets, ACS Applied Materials & Interfaces, 2021, 13, 15925–15938
17. M. Mousa, N. Miljkovic, K. Nawaz, Review of Heat Transfer Enhancement Techniques for Single Phase Flows, Renewable and Sustainable Energy Reviews, 2021, 137, 110566.
18. K. Nawaz, J. Bock, Z. Dai, and A. Jacobi, “Thermal-hydraulic performance of metal foam heat exchangers under dry operating conditions”, Applied Thermal Engineering, 2017, 119(5), 222–232.
19. Z. Dai, K. Nawaz, Y. Park, Q. Chen, A. M. Jacobi “A comparison of metal-foam heat exchangers to compact multi-louver designs for air-side heat transfer applications”, Journal of Heat Transfer Engineering, 2012, 21-30.
20. Z. Dai, K. Nawaz, Y. G. Park, J. Bock, A. M. Jacobi “Correcting and extending the Boomsma-Poulikakos effective thermal conductivity model for three-dimensional, fluid-saturated metal foams”, International communication in heat and mass transfer, 2010, 37 (6), 575-580.
21. J. Sharma, D. A. Cullen, G. Polizos, K. Nawaz, H. Wang, N. Muralidharan, D. B. Smith, Hybrid hollow silica particles: synthesis and comparison of properties with pristine particles, RSC (Royal Society of Chemistry) Advances, Issue 38, 2020.
22. F. Mashali, E. M. Languri, J. Davidson, D. Kerns, W. Johnson, K. Nawaz, G. Cunningham, Thermo-physical properties of diamond nanofluids: A review, International Journal of Heat and Mass Transfer, Volume 129, February 2019, 1123-1135.

23. M. R. Esfahani, M. R. Nunna, E. M. Languri, K. Nawaz, G. Cunningham, Experimental study on heat transfer and pressure drop of in-house synthesized graphene oxide nanofluids, Heat Transfer Engineering, 2018, 1722-1735.
24. K. Nawaz, S. Schmidt, and A. Jacobi. 2015. "A Parametric Study about Mass Diffusion Coefficient of Desiccants for Dehumidification Applications: Silica Aerogels and Silica Aerogel Coatings on Metal Foams." HVAC&R Research 21 (5) 637-647.
25. K. Nawaz, S. Schmidt and A. Jacobi., "Effect of catalysts used in the Sol-Gel process on the microstructure and absorption/desorption performance of silica aerogels", International Journal of Heat and Mass Transfer, 2014, 74, 25-34.

Selected Conference Papers:

1. M. Qu, K. Nawaz, T. Venegas, L. Wang, Effect of geometry and operational parameters on the dehumidification performance of a desiccant coated heat exchanger, 2020 Building Performance Analysis Conference and SimBuild (co-organized by ASHRAE and IBPSA-USA).
2. K. Nawaz, O. Abdelaziz, Characterization of solid desiccant for dehumidification applications, 18th International Refrigeration and Air Conditioning Conference at Purdue, March 2021, Purdue University Lafayette, IN.
3. K. Nawaz, A. M. Jacobi, "Metal foams: Novel materials for air cooling and heating application- Performance under dry, wet and frosted conditions", 16th International Heat Transfer Conference, 2018, August 10-15, Beijing, China.
4. K. Nawaz, A. Jacobi "The Impact of Base Metal on the Thermal-Hydraulic Performance of Metal Foam Heat Exchanger for Cooling and Dehumidification Applications", 16th International Heat Transfer Conference, 2018, August 10-15, Beijing, China.
5. K. Nawaz, B. Fricke, E. Lara-Curzio, " The opportunities and challenges for novel materials for future power generation systems", CIMTEC, 2018, June 4-14, Perugia, Italy.
6. K. Nawaz, A. M. Jacobi, "Open Cell Metal Foam Heat Exchangers for Air-dehumidification Applications", 3rd Thermal and Fluids Engineering Conference, 2018, March 4-7, Fort Lauderdale, FL USA.
7. K. Nawaz, "Thermal-Hydraulic Performance of Wavy-Fin Heat Exchanger Under Dehumidifying Conditions", ASHRAE 2018 Winter Conference January 20-24, Chicago, IL USA.
8. K. Nawaz, A. M. Jacobi, "The Impact of Base Metal on the Thermal-Hydraulic Performance of Metal Foam Heat Exchanger for Cooling and Dehumidification Applications", ASME Heat Transfer Conference, July. 9-14, 2017, Bellevue, Washington, USA.
9. K. Nawaz, J. Bock, and A. Jacobi, "Thermal-hydraulic performance of metal foam heat exchnagers", 14th International Refrigeration and Air Conditioning Conference, July 14th 2012, Purdue University Lafayette, IN
10. Z. Dai, K. Nawaz, Y. Park, Q. Chen, A. M. Jacobi, "A comparison of Metal-Foam heat exchangers to compact multilouver design for air-side heat transfer applications", 7th International Conference on Enhanced, Compact and Ultra-Compact Heat Exchangers: From Microscale Phenomena to Industrial Applications, Sep. 13-18, 2009, Heredia, Costa Rica.

Selected Intellectual Property:

1. US Patent App. 17/974,227, K. Nawaz, B. A. Fricke, X. Sun, S. Sluder, C. Tsouris, M. K. Kidder, C. J. Janke, K. Li, J. A. Thompson "Multi-functional equipment for direct decarbonization with improved indoor air quality"
2. US Patent App. 17/974,232, K. Nawaz, B. A. Fricke, X. Sun, "Intensified carbon capture using building infrastructure."
3. US Patent 11,633,789, E. Lara-Curzio, C. L. Cramer, A. M. Elliott, B. A. Fricke, P. K. Jain, R. R. Lowden, K. Nawaz, V. M. Rao, M. J. Sandlin, "Compliant heat exchangers, heat pipes and methods for making same"
4. US Patent 17/890,791, J. D. Rendall, K. Nawaz, W. E. Asher, A. F. Elatar, J. Sun, J. Brechtl, X. Liu, K. An, M. Zhang, "Density controlled phase-changing material (PCM) spheres for increased heating power and optimal delivery temperature in hot-water tanks"
5. US Patent 63/460,911, Gabriel M Veith, Robert L Sacci, Kashif Nawaz, Kai Li, conversion of liquid CO2