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Weixing Hao

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Education

University of Miami — Miami, FL, U.S.
Ph.D. in Chemical, Environmental and Materials Engineering; GPA:4.0/4.0; 8/2022 - present
- **Research Interests:** Aerosol and air quality; Aerosol instrumentation; Aerosol health effects; Nanoparticles measurement; Bioaerosols; Occupational health; Inhalation toxicology.
- **Supervisor:** Yang Wang

Missouri University of Science and Technology (transferred to the University of Miami) — Rolla, MO, U.S.
Ph.D. in Civil and Environmental Engineering; GPA:3.88/4.0; 8/2019 - 8/2022
- **Research Interests**: Aerosol and air quality; Air filtration; Aerosol instrumentation; Aerosol health effects; Nanoparticles measurement; Bioaerosols; Occupational health; Inhalation toxicology.
- **Supervisor**: Yang Wang

University of Science and Technology Beijing — Beijing, China
M.E. in Metallurgical Engineering; GPA: 3.66/4.0; 9/2016 - 1/2019

North China University of Science and Technology — Tangshan, China
B.E. in Metallurgical Engineering; GPA: 3.34/4.0; 9/2012 - 7/2016

Employment

Pacific Northwest National Laboratory — Richland, WA, U.S.
Visiting Researcher 10/2023 - 1/2024

University of Miami — Miami, FL, U.S.
Graduate Research Assistant 8/2022 - present

Missouri University of Science and Technology — Rolla, MO, U.S.
Graduate Teaching Assistant 1/2020 - 5/2022
- ENV ENG 5662 - Air Pollution Control
- ENV ENG 3603 - Chemical Fundamentals of Environmental Engineering
- ENV ENG 2601 - Fundamentals of Environmental Engineering and Science

Missouri University of Science and Technology — Rolla, MO, U.S.
Graduate Research Assistant 8/2019 - 8/2022

Professional Projects

Filtration performances of household materials as candidates for facemasks. 8/2019 - 10/2021
- Investigated the filtration performance of common materials for potential use as filters in 3D-printed respirators and DIY facemasks during the COVID-19 pandemic.
- Determined the factors influencing the filtration performance of homemade face masks.
- Evaluated the filtration efficiency of over 250 different non-medical and fabric materials and freely shared with the public.
- Assessed the breathability of each material to ensure user comfort.
- Achieved similar N95 filtration efficiency using multiple layers of household air filters without significant flow resistance increase.
- Recommended manufacturing homemade facemasks with a combination of fibrous and fabric materials to guarantee the sufficient removal of aerosols.
- Determined that washing and drying showed good reusability for fabric materials.
- Boosted filtration performance with triboelectric charging, but its fleeting effect due to charge dissipation suggests limited utility in homemade face coverings.
- Captured significant media attention from leading outlets such as the New York Times, BBC News, NPR News, etc.
- Technologies Utilized: Scanning Mobility Particle Sizer; Aerodynamic Particle Sizer; Condensation particle Counter; Constant Output Atomizer; Air Sampling Cassette; Scanning Electron Microscope; Manometer; Digital Microscope.

Model simulation of laminar flow Condensation Particle Counters (CPC). 8/2019 - 5/2023
- Examined the performance of alcohol-based and water-based CPCs through numerical simulation.
- Understood the effects of varying operating conditions (temperature, flow rate, inlet pressure, geometry) and working fluids on CPC performance.
- Employed COMSOL software for comprehensive numerical simulations of CPCs and post-processing of MATLAB.
- Incorporated particle activation and droplet growth within the simulations.
- Identified that lowering the condenser temperature, reducing the diameter of the condenser tube and using a lower aerosol flow rate through the capillary can enhance the activation of sub-3 nm particles.
- Observed that droplet growth reduction becomes pronounced under low-pressure scenarios, potentially impacting counting efficiency.
- Offered insights beneficial for future adjustments and enhancements in CPCs tailored to sub-3 nm particle detection.
- Provided guidance for optimizing vWCPC performance, especially for precise particle detection and atmospheric aerosol monitoring.
- Technologies Utilized: COMSOL Multiphysics simulation coupled with MATLAB.

Understanding the evolution and transport of indoor bioaerosols. 9/2020 - 10/2024

- Understand the viability of bioaerosols based on their sizes in indoor environments, factoring in ultraviolet germicidal irradiation, ozone, time decay, relative humidity, and temperature influences.
- Develop a simulated respiratory system for producing secondhand smoke and mimicking aerosol deposition akin to the human respiratory system.
- Established a chamber specifically for bioaerosol generation.
- Evaluated pathogen viability within bioaerosols using a combination of culture and qPCR techniques.
- Demonstrated size-dependent effect of ultraviolet germicidal irradiation, more markedly reducing the normalized viability of *E. coli* in smaller-sized (0.25 – 0.5 μm) bioaerosols compared to larger ones (0.5 – 2.5 μm).
- Identified three filter media producing deposition efficiencies closely aligned with three human respiratory system regions across a broad submicron size spectrum.
- Technologies Utilized: Sioutas Cascade Impactor; Gelatin filter; SKC BioSampler; 6 Jet Refillable Collison Nebulizer; Bacterial culture methods; qPCR molecular science; Inductively Coupled Plasma Mass Spectrometry.

Selected Publications

Peer-reviewed journal papers (Citations: 184):

- **Hao, W.,** A. Parasch, S. Williams, J. Li, H. Ma, J. Burken, Y. Wang. 2020. Filtration performances of non-medical materials as candidates for manufacturing facemasks and respirators. International Journal of Hygiene and Environmental Health 229:113582.
- **Hao, W.,** G. Xu, Y. Wang. 2021. Factors influencing the filtration performance of homemade face masks. Journal of Occupational and Environmental Hygiene 18:128-138.
- **Hao, W.,** Stolzenburg, M., Attoui, M., Zhang, J., & Wang, Y. 2021. Optimizing the activation efficiency of sub-3 nm particles in a laminar flow condensation particle counter: Model simulation. Journal of Aerosol Science, 158, 105841.
- Gonzalez, A., Aboubakr, H. A., Brockgreitens, J., **Hao, W.,** Wang, Y., Goyal, S. M., & Abbas, A. 2021. Durable nanocomposite face masks with high particulate filtration and rapid inactivation of coronaviruses. Scientific reports, 11(1), 1-11.
- **Hao, W.,** Kapiamba, K. F., Abhayaratne, V., Usman, S., Huang, Y. W., & Wang, Y. 2022. A simulated respiratory system for secondhand smoke generation and characterization. Inhalation Toxicology, 1-11.
- Kapiamba, K., **Hao, W.,** Adom, S., Liu, W., Huang, Y., Wang, Y. 2022. Examining the metal contents in primary and secondhand aerosols released by electronic cigarettes. Chemical Research in Toxicology, 35, 954-962.
- Cheng, S., **Hao, W.,** Wang, Y., Wang, Y., & Yang, S. 2022. Commercial Janus Fabrics as Reusable Facemask Materials: A Balance of Water Repellency, Filtration Efficiency, Breathability, and Reusability. ACS Applied Materials & Interfaces, 14(28), 32579-32589.
- Brooks, J. P., Lupfer, C., Yang, W., **Hao, W.,** & Kapiamba, K. F. 2022. The effect of hypochlorous acid on the filtration performance and bacterial decontamination of N95 filtering facemask respirators. American Journal of Infection Control, 1-5.
- **Hao, W.,** F. Mei, S. Hering, S. Spielman, Y. Wang. 2023. Mapping the performance of a versatile water-based condensation particle counter (vWCPC) with numerical simulation and experimental study. Atmospheric Measurement Techniques, 16, 3973–3986.
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Patent

- **Hao, W.,** Huang, Y., Wang, Y. Simulated respiratory system and method," No. 63/323,698, 2022.

Academic Activities

Conference: technical oral and poster presentations:

- 10/2023 Oral presentation, 2023, 41st Annual American Association for Aerosol Research (AAAR), titled "Mapping the Performance of a Versatile Water-based Condensation Particle Counter (vWCPC) with Numerical Simulation and Experimental Study."
- 10/2022 Poster presentation, 2022, 40th Annual American Association for Aerosol Research (AAAR), titled "Influence of UV Irradiation on the Size-dependent Survivability of *E. Coli*-containing Bioaerosols."
- 03/2022 Poster presentation, 2022, Center for Biomedical Research (CBR) Symposium, Missouri S&T, titled "Measuring the load and viability of biological aerosols."
- 10/2021 Oral presentation, 2021, 39th Annual American Association for Aerosol Research (AAAR), titled "Optimizing the activation efficiency of sub-3 nm particles in a laminar flow Condensation Particle Counter by model simulation."
- 10/2021 Oral presentation, 2021, 39th Annual American Association for Aerosol Research (AAAR), titled "A simulated respiratory system for secondhand smoke generation and characterization."
- 10/2020 Oral presentation, 2020, 25th Annual Mid-American Environmental & Engineering Conference (MAEEC), titled "Filtration performance of common non-medical materials used in homemade face coverings."
- 10/2020 Poster presentation, 2020, 38th Annual American Association for Aerosol Research (AAAR), titled "Filtration performances of non-medical materials as candidates for homemade face mask filters."
- 10/2019 Poster presentation, 2019, 24th Annual Mid-American Environmental & Engineering Conference (MAEEC), titled "Enhancing the detection efficiency of sub 3 nm aerosols with a modified condensation particle counter."

Professional Services

Reviewer Activities of Journals: 28 publications peer review from 10 journals:

- PLOS One; Scientific Report; Aerosol Science & Technology; Atmospheric Measurement Techniques; Planetary and Space Science; ACS Omega; Journal of hazardous materials; Journal of Aerosol Science; ACS Environment & Health; Frontiers of Environmental Science & Engineering

Professional Membership: American Association for Aerosol Research (AAAR).

Selected Media coverage on particle filtration during COVID-19:

- New York Times: https://www.nytimes.com/article/coronavirus-homemade-mask-material-DIY-face-mask-ppe.html
- BBC News: https://www.bbc.com/future/article/20200504-coronavirus-what-is-the-best-kind-of-face-mask
- NPR News: https://www.npr.org/sections/goatsandsoda/2020/04/22/840146830/adding-a-nylon-stocking-layer-could-boost-protection-from-cloth-masks-study-find
- C&EN News: https://cen.acs.org/materials/Scientists-take-closer-look-materials/98/i25
- Daily Herald: https://www.dailyherald.com/news/20200407/what-makes-for-a-good-homemade-face-mask