

CHEMICAL AND ENVIRONMENTAL ENGINEERING
COLLEGE OF ENGINEERING & APPLIED SCIENCES

RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: April 29, 2024

PROJECT TITLE: Microplastic and nanoplastic release from automotive tire tread

Physical Requirement : Need to travel to several collaborating labs in Cincinnati, Akron, and Chicago

Project's Technical Skills Requirement : General experimental and synthetic chemistry techniques, exposure to html webpage development, interpersonal skills for multisite collaboration

Project's Available Positions : Two National Science Foundation Research Experience for Students

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In the US, automotive tire wear generates nearly a million tons of tire wear particles annually, making up 40% of microplastic pollution, predominantly made of 100-micron cylindrical particles. This unregulated particulate emission from tires exceeds the regulated emission from exhaust by three orders of magnitude. With electric supplanting internal-combustion vehicles, tire wear particle emissions will increase due to higher torque and vehicle weight. Automotive tire tread is composed of 25-30% nanoparticles of carbon black and/or silica by mass. In preliminary work, nanoscale tire wear particles have been found adhering to the surface of in-use tires and can be collected from laboratory rubber abraders as an aerosol. This project explores the mechanisms for release of nanoparticles during tire wear. Through these mechanisms, new approaches to control environmental exposure are being explored. The work involves a close collaboration between industry, the National Institute of Occupational Safety and Health, and UC funded by the National Science Foundation. The project takes advantage of Department of Energy user research facilities at the Advanced Photon Source, Argonne National Laboratory. The collaboration has broad expertise and extensive facilities to study the mechanism for nanoparticulate and microplastic emissions from tires and to develop and implement viable solutions to the problem for regulatory, and commercial implementation, as well as for fundamental understanding. The project also involves high school students from St. Xavier High School in the collection of tire wear particles samples from domestic cars and trucks and to develop a webpage for submission of samples from other high schools across the US and to serve as the basis for a

national forum of public discussion on nanoparticle and microplastic environmental exposure.

Two undergraduates from UC will be supported by Research Experience for Undergraduates grant to collaborate with a graduate student, a high school teacher and several high school students to develop electrostatic precipitators for charged nano and micro plastics produced from a laboratory rubber abrader and instruments at Akron Rubber Development Laboratory, NIOSH/HELD lab in Norwood and Argonne National Lab in Chicago. This research contributes to the fundamental understanding of nanoparticle release from polymer nanocomposites driven by interfacial charge. The undergraduates will also help in the development and maintenance of a public webpage mentioned above.

Preferred skills:

- General capabilities in experimental and chemical synthetic techniques.
- Exposure to webpage development/html.
- Interpersonal skills for working in a group.

Training provided:

- Exposure to the scientific basis for the major source of microplastics pollution and its abatement.
- Cross-discipline collaboration skills. Work in national research facilities.
- Coauthor and possibly lead author on publications, presentations, and webpage.