

Project title:	Plastics in the Air: Quantifying sources and sinks with novel detection methods
Discipline	Waste Management, Engineering, Environmental Sciences
Key words:	Plastic, Pollution, Contamination, Airborne, Imaging
Supervisory team:	Carl Boardman, Alex Forsey, Toni Gladding
URL for lead supervisor's OU profile	http://www.open.ac.uk/people/cpb247

Project Highlights:

- Opportunity to work on a societally important public health related research question relevant to industry with high impact.
- Contemporary environmental issue investigated with extensive UK-based field work;
- Varied and multidisciplinary (chemistry/biology/engineering) laboratory opportunities;

Overview:

Microplastic (plastics <5mm) pollution has been detected in every major natural ecosystem and built environment across the world, this includes remote regions such as the Pyrenees, the Arctic and the Mariana trench [1]. Whilst plastic pollution in the world's oceans has received a tremendous amount of publicity and attention [2, 3], the next emerging area will be airborne microplastic contamination of the atmosphere and the threat this poses to human health and ecosystem function [4, 5].

A definitive account of airborne plastic source(s) and extent in external environments is currently not available, with very few published scientific papers on this topic. To date, it's clear that fibrous microplastics are present within internal environments (e.g. see accompanying figure), which are likely to originate from clothing and textiles, however plastic pollution in external environments has only recently started to be investigated [6]. This project would address this research gap by using novel engineering analytical techniques to quantify atmospheric loadings.

This project would quantify the presence of plastics in the air in both internal and external environments. At present there is not a standardised approach to

measuring airborne plastic, therefore this studentship will require a range of established air quality monitoring techniques to be explored. In parallel, completely novel approaches from outside the air quality field will be investigated. This will include using optical imaging techniques and machine learning to establish a potentially low-cost approach that could eventually be used on drones and smartphones.

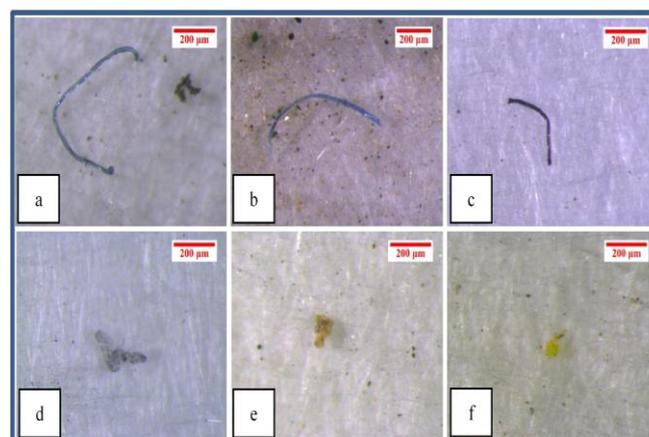


Figure. Photographs of typically observed microplastics. A-C; fibres. D-E; fragments. F granules. Credit Liu, Wang [5].

When analytical techniques are established it is envisaged that this studentship would then quantify the microplastic load in the air from industrial sources. For example, waste facilities, plastic manufacturers and agricultural processes all have the potential to release a significant amount of microplastics to the environment. Having an applied/industrial angle to the project will increase the likely impact the results from the project will have. At a range of sites, the size and shape of airborne microplastics in the atmosphere will be measured alongside their composition.

Methodology:

The project would use high velocity sampling pumps deployed at likely sources (e.g. industrial sites, roads and within buildings) to sample the air for plastic. The subsequent samples would be analysed using biological and chemical preparation techniques [7]; Fourier transform infra-red and Raman spectroscopy would be used for identification [8]. It is the intention that this project would develop new optical techniques that would permit the 3D mapping of plastic in the air.

References & Further reading:

1. Enyoh, C.E., et al., *Airborne microplastics: a review study on method for analysis, occurrence, movement and risks*. Environmental Monitoring and Assessment, 2019. **191**(11): p. 668.
2. BBC. *Plastic Action*. 2020 02/01/20]; Available from: <http://www.bbc.co.uk/programmes/articles/11CnCQR0GJfkDgJs57sR5Ps/plastics-action>.
3. Haward, M., *Plastic pollution of the world's seas and oceans as a contemporary challenge in ocean governance*. Nature Communications, 2018. **9**(1): p. 667.
4. Dris, R., et al., *Synthetic fibers in atmospheric fallout: A source of microplastics in the environment?* Marine Pollution Bulletin, 2016. **104**(1): p. 290-293.
5. Liu, K., et al., *Source and potential risk assessment of suspended atmospheric microplastics in Shanghai*. Science of The Total Environment, 2019. **675**: p. 462-471.
6. Dris, R., et al., *A first overview of textile fibers, including microplastics, in indoor and outdoor environments*. Environmental Pollution, 2017. **221**: p. 453-458.
7. Erni-Cassola, G., et al., *Lost, but Found with Nile Red: A Novel Method for Detecting and Quantifying Small Microplastics (1 mm to 20 μ m) in Environmental Samples*. Environmental Science & Technology, 2017. **51**(23): p. 13641-13648.
8. Cabernard, L., et al., *Comparison of Raman and Fourier Transform Infrared Spectroscopy for the Quantification of Microplastics in the Aquatic Environment*. Environmental Science & Technology, 2018. **52**(22): p. 13279-13288.

Further details:

A project in this area would suit a person who has a physical sciences, biology or engineering background. This project would be multidisciplinary, therefore there would be a requirement to learn a wide range of cross disciplinary techniques under the supervision of experts. Experience using programming languages would be advantageous, but not essential. Research in this area could be tailored to the skills and interests of a successful applicant. A student would join a well-established environmental and analytical team researching plastic waste materials at the Open University. Please contact Dr Carl Boardman (Carl.Boardman@open.ac.uk) for further information.

Applications should include:

- A 1000 word cover letter outlining why the project is of interest to you and how your skills match those required
- An academic CV containing contact details of three academic references
- [Open University application form](#)
- Applicants will need to demonstrate good competence in the English language. To be eligible for a full award, a student must have no restrictions on how long they can stay in the UK and have been ordinarily resident in the UK for at least 3 years prior to the start of the studentship.

Applications should be sent to STEM-EI-PhD@open.ac.uk by **24.04.20**

