



# A low-cost Raman microscope for detecting microplastics in the ocean

## Type of the project

Semester project

## Laboratory

Laboratory of Nanoscience for Energy Technologies

## Professor

Professor Giulia Tagliabue and Florian Breider

## Supervisor

Dr Alan Bowman

## Contact person at Sailowtech

Shan Yao, Arthur Tabary

## Student

To be determined

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## Context

Microplastics are a significant source of pollution in lakes and oceans worldwide. While this is well known, the effects of microplastics on the marine environment, and even the size and distribution of microplastics in the ocean, remains poorly understood. Thus, it is imperative that we develop methods to quantify environmental plastic pollution in water sources and be able to rapidly scale these methods.

Sailowtech is an association and a MAKE project that aims to raise awareness of environmental issues, particularly those relating to aquatic environments. It promotes frugal and participative field science, open-source science, and low-tech approach. To achieve this, Sailowtech organizes scientific sailing expeditions in lakes, seas, and oceans to discover field science, test the protocols and devices build by students during the semester.

## Description of the project

Raman spectroscopy – which analyses the light scattered by a laser beam on a sample - is a technique that can be used to identify plastics, as each plastic has a unique optical fingerprint. Furthermore, when coupled to a microscope, plastics down to  $< 1 \mu\text{m}$  in diameter can be studied. However, most commercial Raman microscopes are bulky, expensive pieces of equipment not fit for use on a boat. **The aim of this project is to**



### **construct a low cost, small Raman microscope for use on a Sailowtech cruise.**

Several examples of low cost Raman systems exist in the literature, though these have not been adapted for use on boats. This project will be broken into two parts: i) a review of low-cost Raman microscope systems available in the literature; ii) the construction of a low-cost Raman microscope. A highly successful project will result in a device that can be used on a future Sailowtech cruise.

The ideal student for this project will have a track record in design and fabrication of experimental equipment or other mechanical components (e.g. via 3D printing) and an interest in microplastics and optical spectroscopy.

Professor Breider has significant experience in the field of microplastics. Professor Tagliabue and Dr Bowman have significant experience in building Raman microscope systems and have collaborators specializing in low-cost systems. Thus, this project is achievable in the time scale available.

### **Deliverables**

1. An assessment of the state-of-the-art low-cost Raman microscope systems available.
2. A functioning Raman microscope that can be used on a future Sailowtech cruise.
3. A written report presenting the results and work accomplished during the project.
4. An oral presentation at the end of the semester to present the results of the project.
5. A document explaining how to build the device to make it reproducible.

### **Documentation**

As a starting point, here are some publications of previous lower (not all low!) cost Raman spectrometers:

<https://www.open-raman.org/>

<https://www.tandfonline.com/doi/full/10.1080/00387010.2022.2117200>

<https://pubs.acs.org/doi/10.1021/acs.jchemed.0c01028>

<https://transmitter.ieee.org/makerproject/view/4dab0>

### **Planned interaction with Sailowtech**

The aim of this project is to fabricate a device that can be used on a Sailowtech cruise. Consequently, there will be several meetings with Sailowtech (about 3/4 in the semester) to follow the progress of the project and to assess additional requirements for remote measurement (e.g. maximum power the spectrometer can use, its robustness to vibrations etc...). In addition, you will be counted as a member of Sailowtech, and will therefore be able to take part in the various activities and potentially test the device during one of our expeditions.



## Contact

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