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A facile approach to detect plastic nanoparticles using Raman microscopy

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Introduction

- Microplastics are a globally prominent pollutant that are becoming increasingly harmful to the environment.
- Because these plastics pose a potential public health threat, an accurate method of detection is important.
- Originally, the goal of this project was to use metal nanoparticles and SERS to detect the presence of microplastics while salt was introduced to improve aggregation
- However, control samples showed that microplastics smaller than 10 uM in solution with salt were detectable with Raman alone
- Optimization of this method could lead to a cheap and rapid procedure for accurately determining the amount and size of microplastics in a water source.

Methods

- Mixtures of salt and microplastics were applied to small filter membrane using a vacuum filter.
- Raman microscope was used to create a mapping of a large area of each filter membrane.
- Chemigram images were created by detecting where in the mapping peaks at 1000 cm^{-1} had achieved a certain number of counts

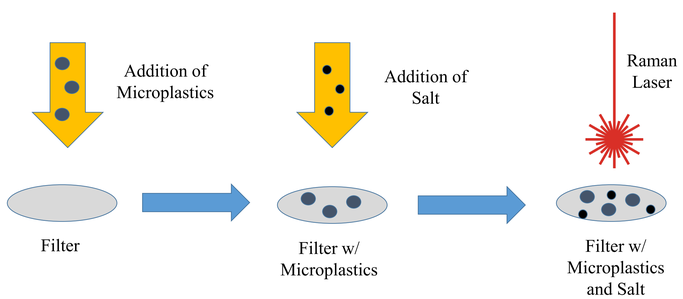

Figure 1. Procedure for preparing microplastic samples on filter

Results

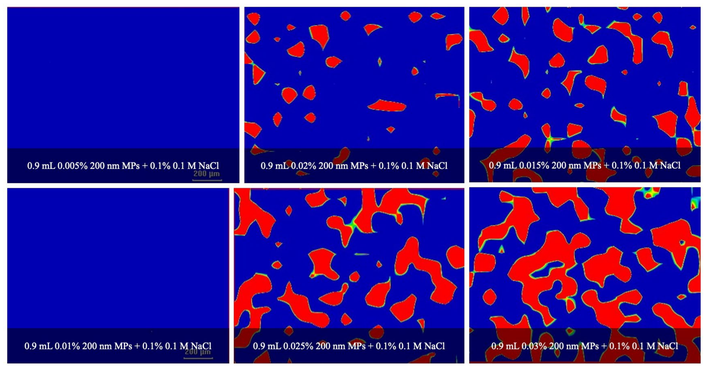

Figure 2. Mapping of Raman signal at 1000 cm^{-1} for increasing amounts of 200 nm microplastics

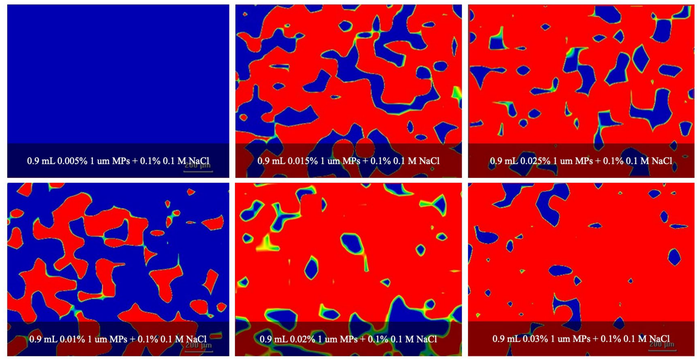

Figure 3. Mapping of Raman signal at 1000 cm^{-1} for increasing amounts of 1 um microplastics

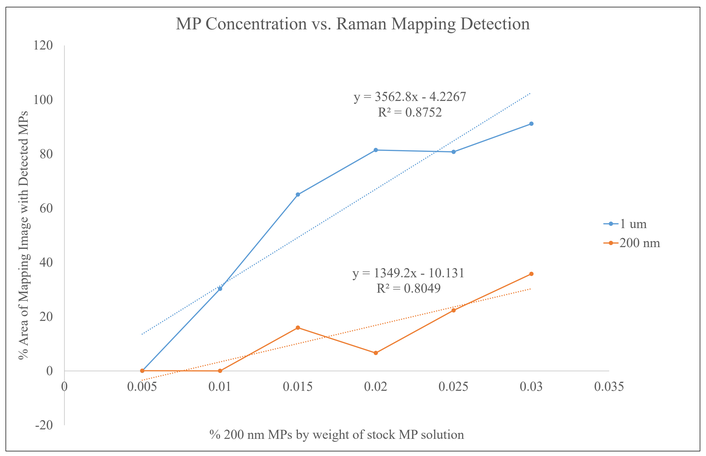

Figure 4. Amount of detected microplastics via Raman vs. concentration of tested sample

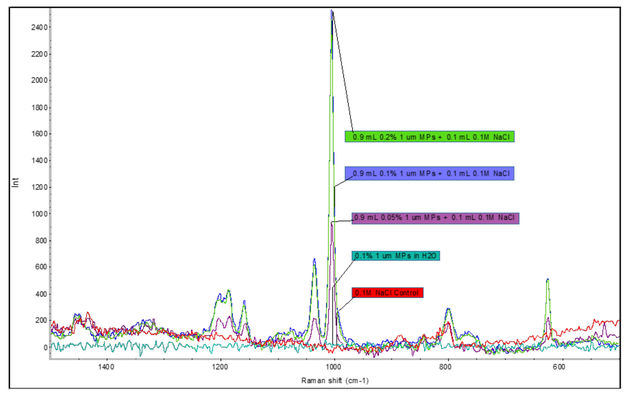

Figure 5. Raman signal of samples with microplastics and salt compared to control samples of microplastics and salt

Conclusion

- The presence of sodium chloride salt in filtered samples of microplastics as small as 200 nm in diameter makes them detectable through Raman mapping.
- Salt is known to aggregate particles and is used commonly with nanoparticle matrices for this reason.
- The accuracy of the produced calibration curve is decent but could be improved with process improvements.
- Future tests will involve testing water samples stored in polystyrene containers to see if microplastics are detected from deterioration.
- Additionally, other spectroscopic methods will be used to further characterize this phenomenon.

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