

# Concentration of nano- and microplastic particles from environmental samples

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## Abstract



Microplastics

Nano- and microplastic particles are ubiquitous in the global environment and are an emerging topic of human health research. These particles have been found in our air, water, soils and foods (e.g., Shruti et. al., 2020). The Concentrating Pipette Select is a widely used concentrator for microbiology that can also be used to separate and concentrate nano- and microplastic particles for observation and analysis.

This process is accomplished through collection of the particles in the lumen of hollow fiber ultrafilters or submicron filters, passing the liquid matrix to waste. After concentrating the particles in the lumen of the filters, they are swept out using and elution fluid of wet foam. Following elution, the fluid collapses leaving the particles in a very small final volume of fluid. Data are presented showing the concentration from environmental water of spiked-in commercially available nano- and microplastic polystyrene particles.

## Background

The Concentrating Pipette (CP) benchtop microparticle concentrator uses a patented Wet Foam Elution (WFE) technology for exceptionally fast, efficient concentration based on capturing microorganisms or particles from large volumes of liquid using a hollow fiber concentrating pipette tip with a very high surface area (98 cm<sup>2</sup>). The pipette tips are available in a range of pore sizes, including an ultrafilter. Once the sample is filtered, it is followed by instant recovery with a button press using WFE, which uses a standard buffer, a weak surfactant as a foaming agent, and dissolved gas packaged in quick release canisters to dispense the wet foam.

During elution, the buffer is quickly dispensed - expanding 6x into a viscous wet foam that lifts the trapped particles from the filter in a volume of 250 µL to 1 mL or more. Once dispensed, the foam returns to a liquid within seconds, ready for downstream analysis methods. The exceptional characteristics of the wet foam enable concentration factors, up to 10,000x.

The WFE process is used with other concentration devices including the EasyElute™ Large Volume Concentration Kit for liquid volumes up to 100 L as well as the AirPrep™ Samplers that collect airborne particles from 0.01µm to 10 µm in size.

## Methods

Polystyrene latex microspheres (PSMs) of defined size and surface chemistry are commonly used to calibrate particle sizing instruments as well as environmental capture and delivery parameters. For air sampler aspiration and transmission (sampling) efficiency, PSMs are disseminated using a method such as nebulization or spraying in a liquid. As the liquid evaporates, the particles become microplastic aerosols of a defined size. Similarly, PSMs suspended in a liquid can be sampled and concentrated as defined microplastic particles. Both methods can be combined, by sampling aerosolized PSMs, delivering them into a liquid sample, and then concentrating them further from the liquid sample.

### Concentration and Recovery of Plastics in Air

Environmental nanoplastic and microplastic aerosols disseminated in an aerosol test chamber were collected on dry electret filters using InnovaPrep AirPrep™ samplers, pictured right, which are capable of capturing particles in the size range of 10 nanometers to 11 microns with a 200 LPM flow rate. After elution, they can be used as-is or pooled and concentrated using various means including the CP pictured left.

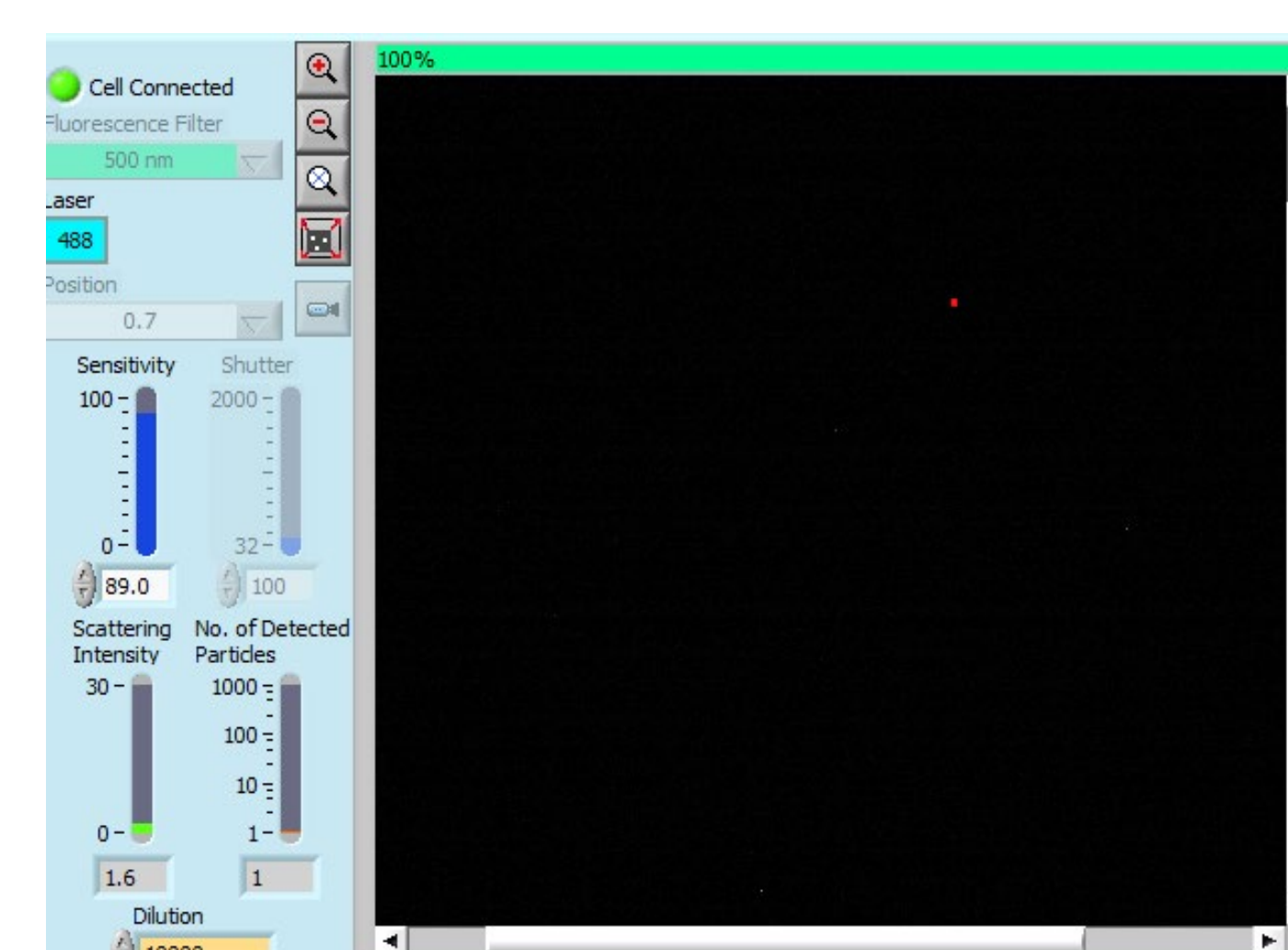


Concentrating Pipette - nano and microparticle concentrator

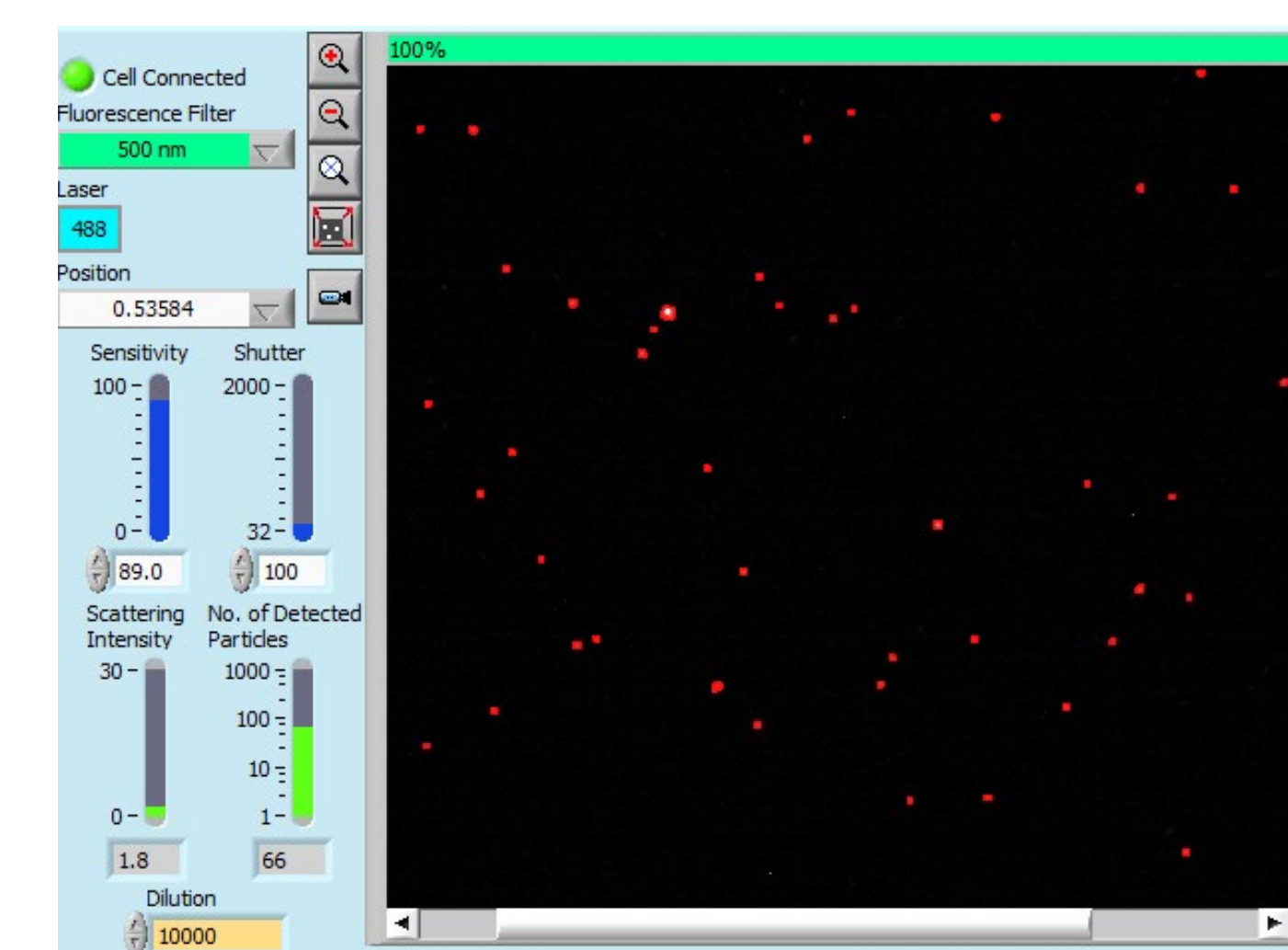
Collection of plastic microspheres using an AirPrep sampler		
Test	3 µm Polystyrene	3 µm Polystyrene
Elution #1 Aspiration & Retention Efficiency, %	86.90%	105.20%
Overall Concentration Factor [(#/L <sub>liquid</sub> )/(#/L <sub>air</sub> )]/min	31,372	41,417
Elution #2 Aspiration & Retention Efficiency, %	22.00%	5.80%
Total A&RE, %	109.00%	111.00%

### Concentration and Recovery of Plastics Suspended in Pond Water

A 1 liter pond water sample was spiked with fluorescent nanoplastic particles. Both an unconcentrated sample and a prefiltered and concentrated sample (1.07 mL) using an ultrafilter Concentrating Pipette Tip were run on a Particle Metrix ZetaView nanotracking analysis (NTA) instrument to count and image the fluorescent nanoplastic particles. The images below show before prefiltration/concentration (left) and after prefiltration/concentration (right). The particle size ranges that can be concentrated using the CP are from 25 nanometers up to about 200 microns. For environmental water samples, a prefiltration step removes the larger “non-target” biological materials. The nanoparticles are then concentrated using the CP.



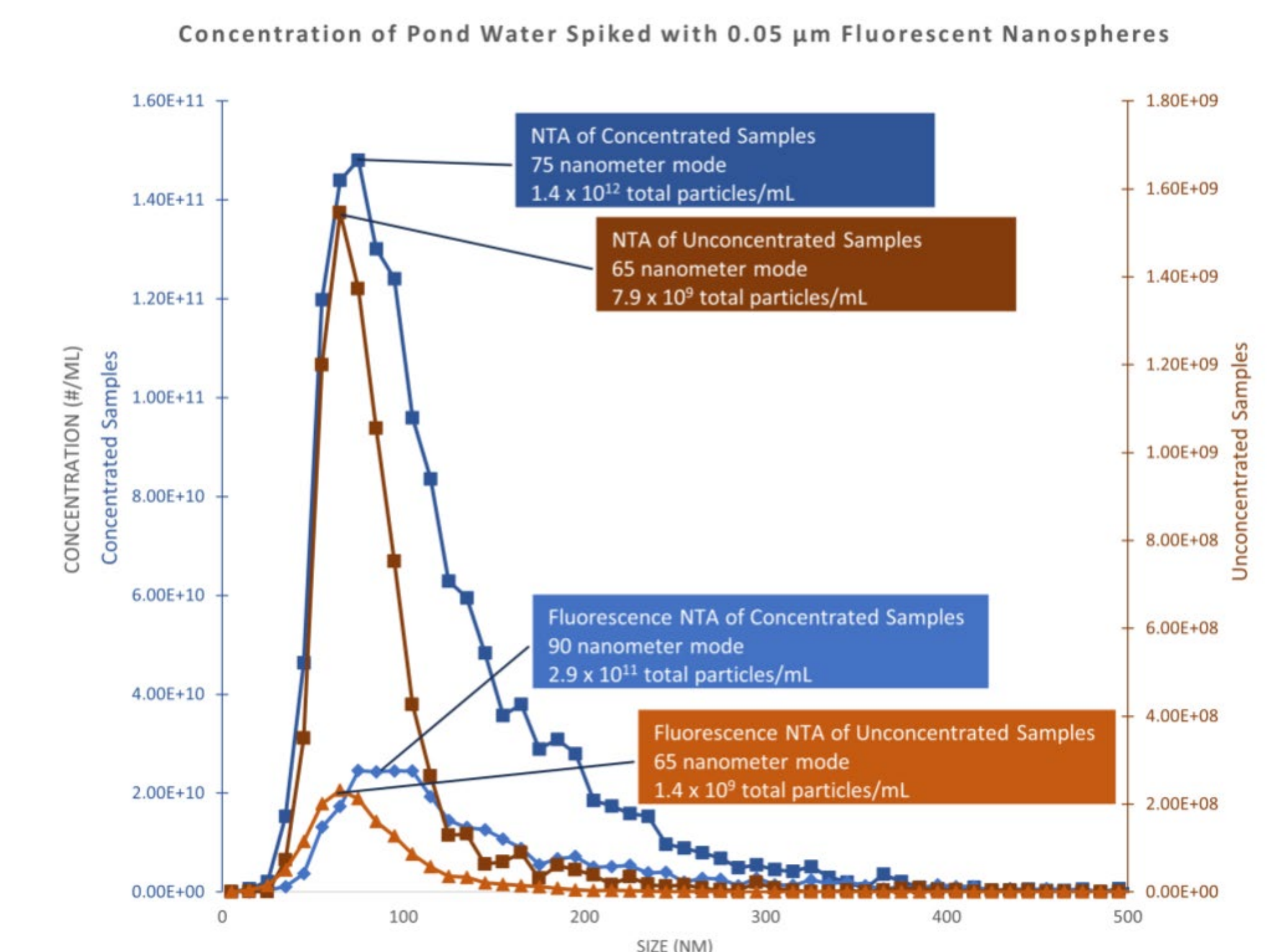
Unconcentrated Water Sample



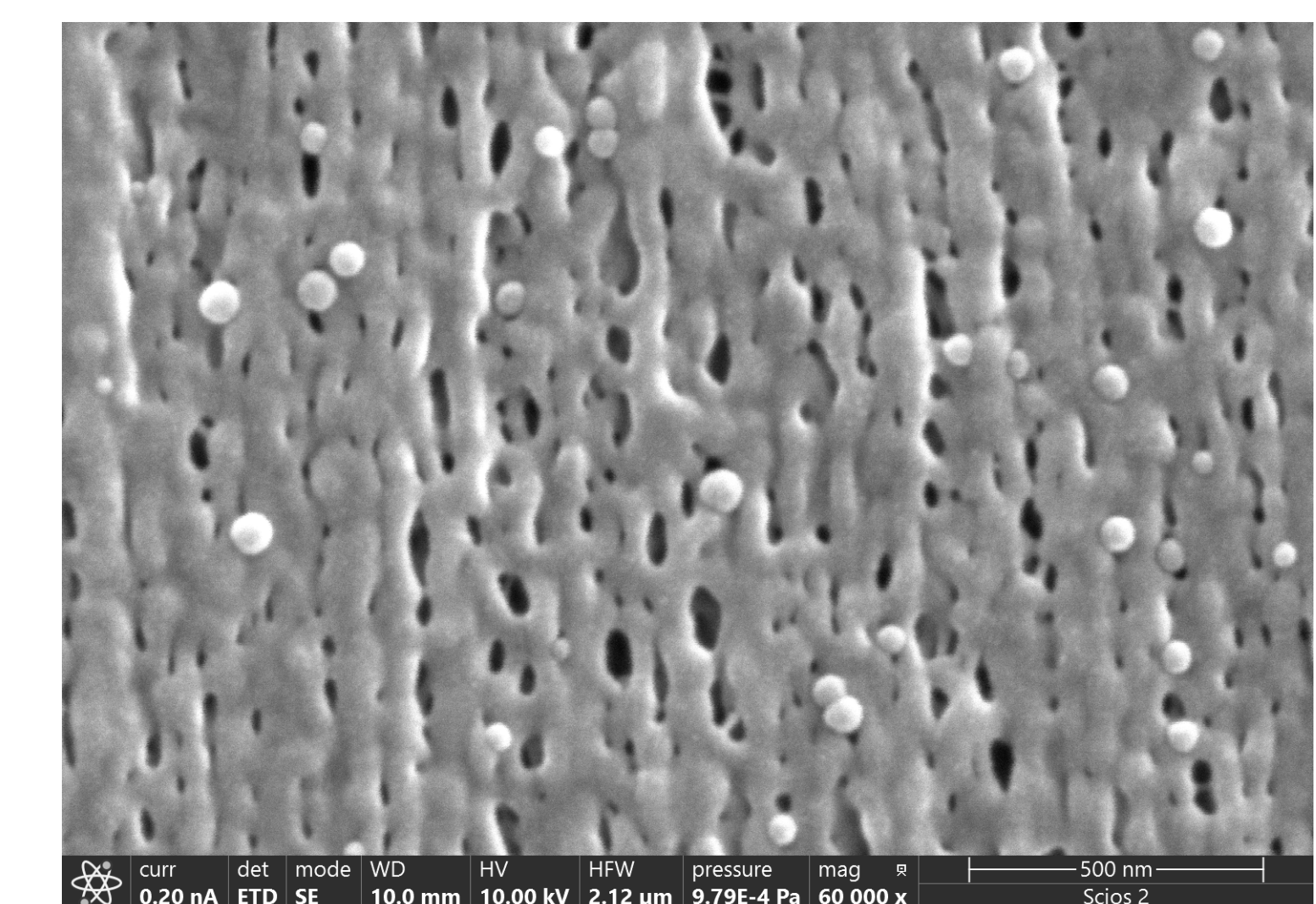
Concentrated Water Sample

## Results

### 50 nanometer polystyrene spheres in retention pond water



### 50 nanometer polystyrene spheres trapped on Ultrafilter CPT



## Conclusions and Future Work

The ability to collect and concentrate environmental nano- and microplastic particles can enhance detection and polymer-specific analysis by delivering the target particles from real world large volumes into a very small volume. The CP Select is a rapid and easy-to-use sample preparation technique and it is compatible with several analytical methods including fluorometric and microscopic techniques. Future work may include environmental and clinical sample research concentration, isolation and analysis of samples by FTIR and MS. Since the CP Select uses sterile food-grade elution materials, it may also be compatible with toxicology studies.

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### Extracting Waterborne or Airborne Particles from Various Filters Using Wet Foam Elution



FLUIDPREP CP Select



FLUIDPREP EasyElute™ LVC Kit



AIRPREP Cub Air Sampler