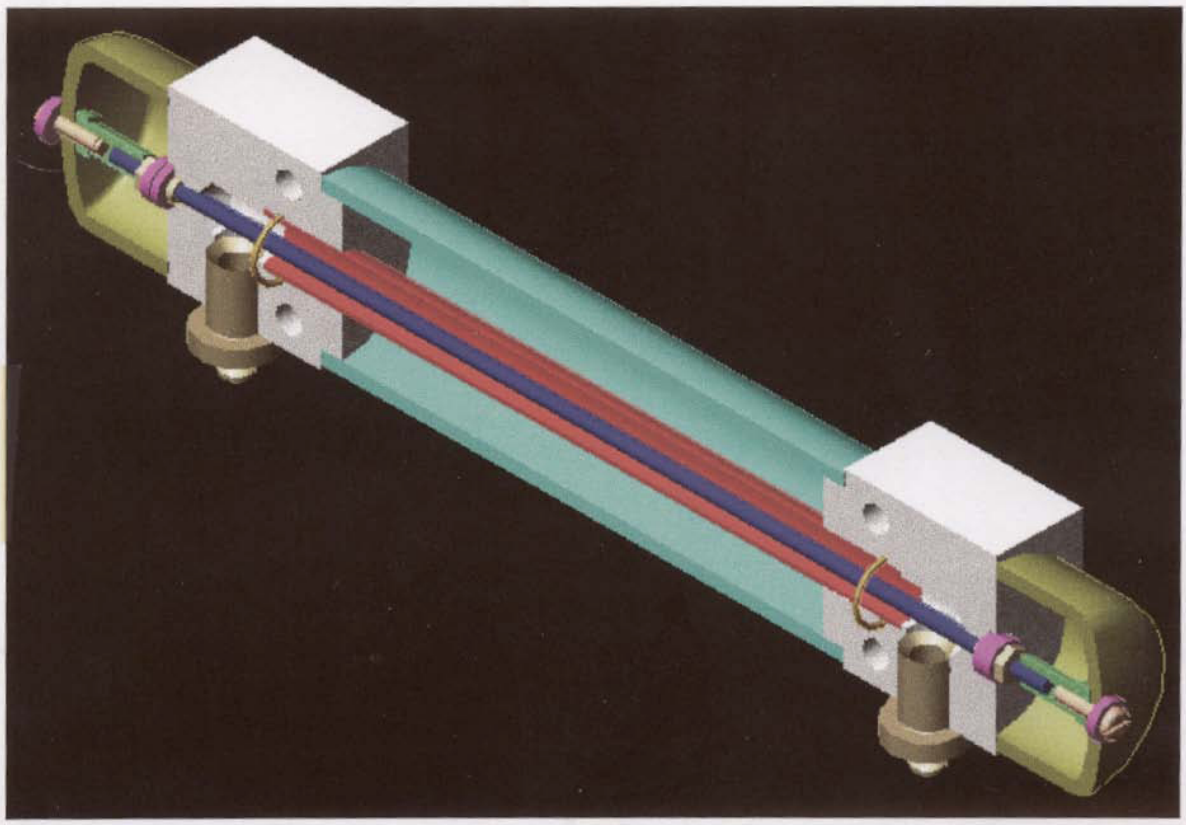
NanoLyzer Theory of Operation and Advantages

(the NanoLyzer is manufactured by Microfier, Inc.)

An analytical product for the measurement and identification of sub-50 nm particles in ultrapure water



Microfier, Inc.
info@microfier.com
(314) 603-0312

Description

The NanoLyzer is a state of art product for measuring and identifying particles to improve ultrapure water (UPW) quality. UPW particles have ionic functional groups and/or carry ionic charges at the hydrophobic interface. NanoLyzer utilizes a carefully configured electromagnetic field to agglomerate and capture charged UPW particles on its electrodes. Reversing the electromagnetic field expels accumulated particles from the electrodes, allowing real-time and off-line laboratory particle analysis techniques. The NanoLyzer has directly demonstrated its ability to effectively capture particles equal to or larger than 12 nm and agglomerate them into larger masses that traditional instruments can measure. Further, indirect data and operational theory suggest it also agglomerates and captures sub-10 nm particles.

The NanoLyzer can operate standalone or can be used to augment the sensitivity, accuracy and capability of traditional optical particle counters (OPC) used to detect particles in UPW:

> *Simplicity:* The NanoLyzer chamber provides a real time signal proportional to waterborne particle concentration. This permits standalone operation if desired.
>
> *Sensitivity:* Traditional OPCs can detect particles greater than 50 nm. The NanoLyzer augments sensitivity by coagulating much smaller particles into agglomerates 100nm and larger for easier OPC detection and measurement.
>
> *Accuracy:* A typical OPC detects particles in a 100 mL sample. The NanoLyzer is more accurate than an OPC because it concentrates particles from 540 Liters prior to analysis ($\sim 10^4$ more concentrated sample). The higher particle concentration significantly improves accuracy by raising signal amplitude with respect to background noise.
>
> *Capability:* In addition to enhancing traditional particle counting, NanoLyzer agglomerates greatly reduce time required to identify particle sources by revealing morphology and elemental composition using standard methods of scanning electron microscopy (SEM) and X-ray diffraction (EDS).

The enhanced simplicity, sensitivity, accuracy, and capability of the NanoLyzer are critical for fabs needing to control and eliminate sub-50 nm particles within UPW systems. The NanoLyzer provides fabs with a tool to improve water quality and troubleshoot system upsets. Importantly, the NanoLyzer helps the fab evaluate and improve unit processes, components (filters), and manufacturing tools.

The NanoLyzer data will help increase device manufacturing yields by helping fabs eliminate sources of particles and evaluating particle removal performance of UPW filtration systems.

Data Output and Analysis Tools

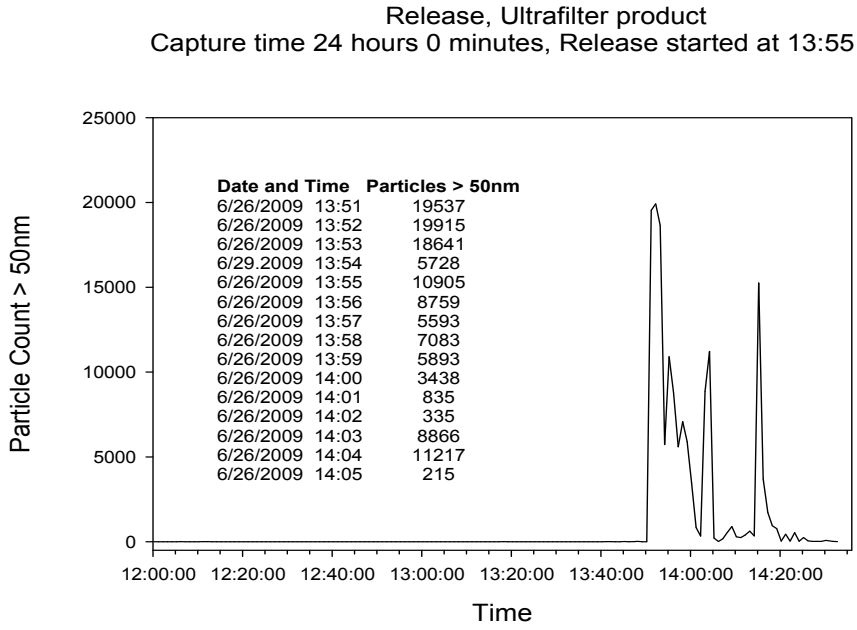
The NanoLyzer provides on-site, real-time analysis of UPW particle concentrations. In addition, captured and then released particles can be collected on a 100nm sample membrane for laboratory analysis that will determine elemental composition, particle concentration/mass, and particle morphology.

Real-time analysis (0 to 24 hours)

Particles from the NanoLyzer can be measured by a traditional OPC or by observing the NanoLyzer interelectrode current (IEC). Note: the data below are from a top-tier fab during an ITRS-sanctioned product demonstration.

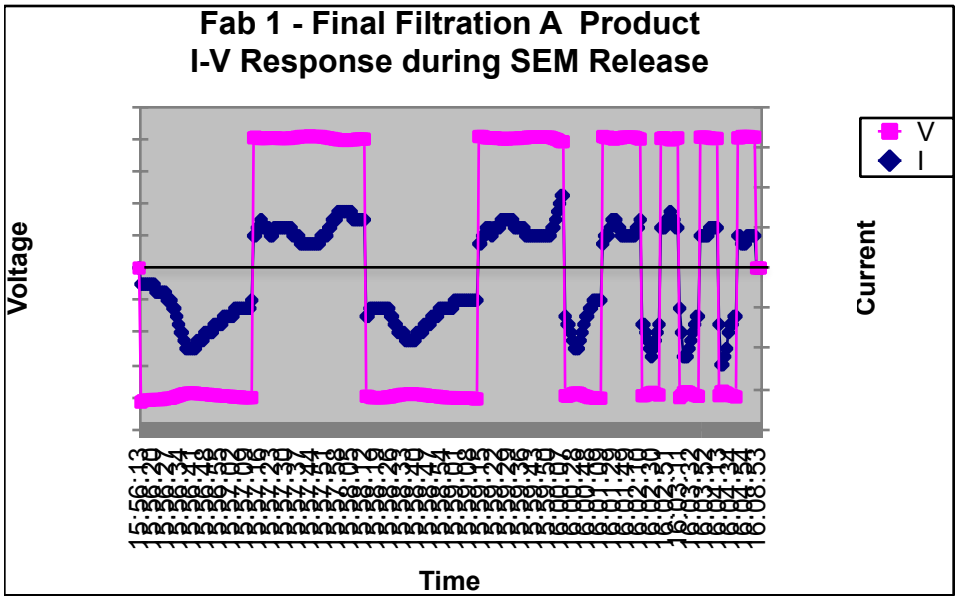
Optical Particle Counter for real-time analysis

An OPC can monitor the release of concentrated agglomerates and individual particles. The OPC response is quantitative related to the concentration of particles and particle mass. See typical OPC data at right.



Interelectrode current (IEC) for real-time analysis

Waterborne particles in the NanoLyzer cause an increase in current between electrodes. The magnitude of the current is a function of the concentration of particles and particle charge characteristics. See typical current response at right obtained during the release of particles from the NanoLyzer.



Laboratory Analysis (24 to 72 hours)

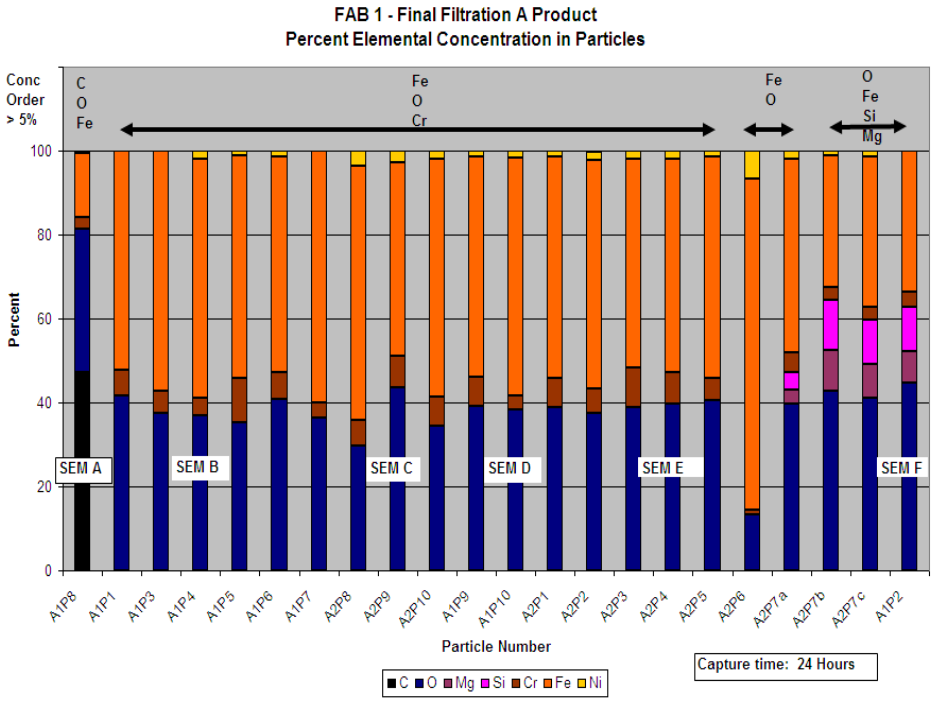
Standard SEM and EDS methods can analyze agglomerates and individual particles to determine particle morphology, elemental composition, and particle concentration to speed identification of particle sources. Note: the data below are from a top-tier fab during an ITRS-sanctioned product demonstration.

Morphology – SEM analysis provides images of released particles.

The morphology in the image at right is clearly that of a rod bacterium.

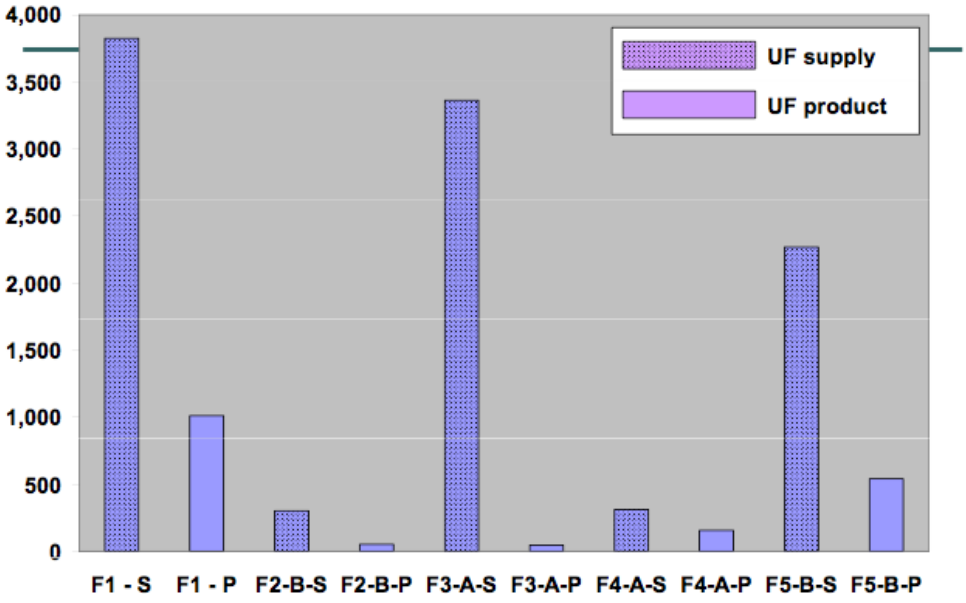
Elemental Composition

EDS analysis of particles provides elemental composition of released particles. The graph at right summarizes elemental composition of 22 different particles found on one sample membrane.



Particle Concentration (particle mass)

SEM analysis of agglomerates and individual particles provides concentration and size of particles. The concentration of particles can be used to document water quality and quantitively monitor unit process (e.g. filter) performance as shown at right to compare UF supply and product quality.



The NanoLyzer provides both real-time and off-line laboratory data for analyzing the concentration, morphology, and elemental composition of particles in UPW. This information is critical to monitoring water quality and improving manufacturing yields by identifying sources of particles quickly and positively.