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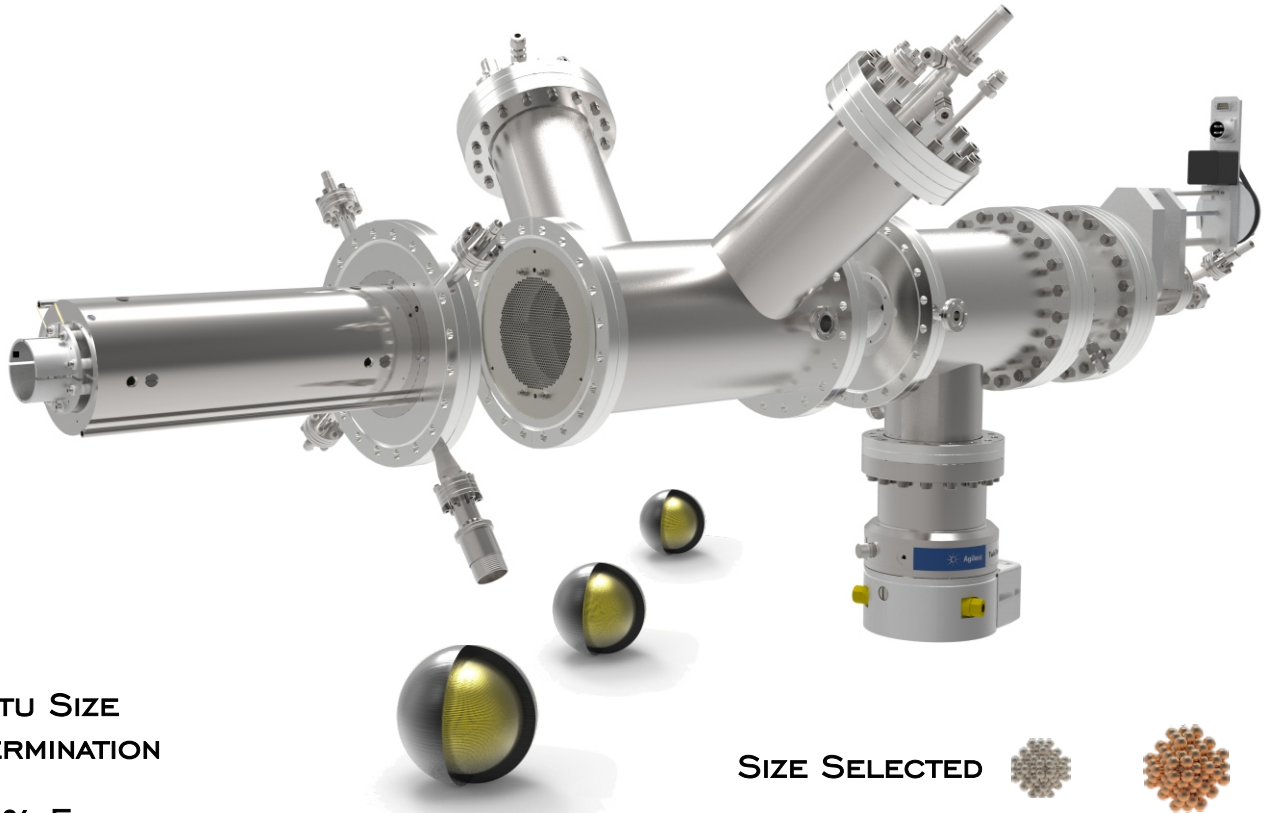
Nanoparticle Deposition

Ultra-pure, size-selected nanoparticles



In-Situ Size determination

+/-2% Filtering

Core-shell Nanoparticles

Size Selected

Alloy NPs

1-20nm • Core-Shell • High-Entropy Alloys

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The Technology

Terminated Gas Condensation

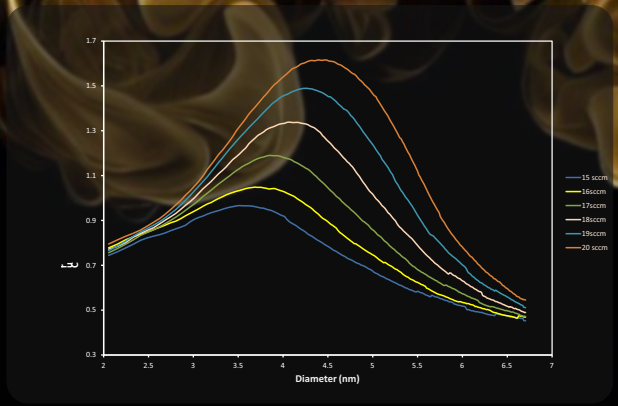
Ultra-pure
size-selected
nanoparticles

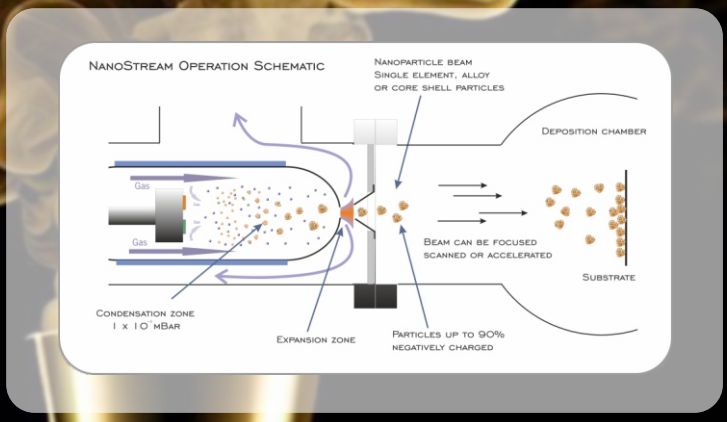
1-20nm
+/- 15% size variation
High degree of charging
Zero contamination

Terminated Gas Condensation (TGC) describes the process in which a vapour condenses into particles at high pressure for a specific length of time such that the size of the particles can be well defined. In the Nanostream sources, Nanoparticles (NPS) are produced by the TGC method using high-pessure sputtering. The sputtered atoms quickly thermalise in the high pressure and Nanoparticles are formed as these thermalised atoms migrate towards the expansion zone.

An advantage of using sputtering is that the NPS generated by this method tend to posses one additional electronic charge and this allows them to be electrostatically manipulated either through deflection, focusing or acceleration. The acceleration towards the substrate allows the particle impact energy to be controlled precisely. At low acceleration (<< 1 eV per atom) the particles soft-land without deformation. At higher energies they undergo a small degree of interface mixing and form a layer of bound nanoparticles. At very high energy the particles fuse to revert to bulk material. Such nanoparticle manipulation produces a wide variety of coating morphologies from nanoparticle powder, through porous films to crystalline structures.

Mean diameter variation
as a function of gas flow





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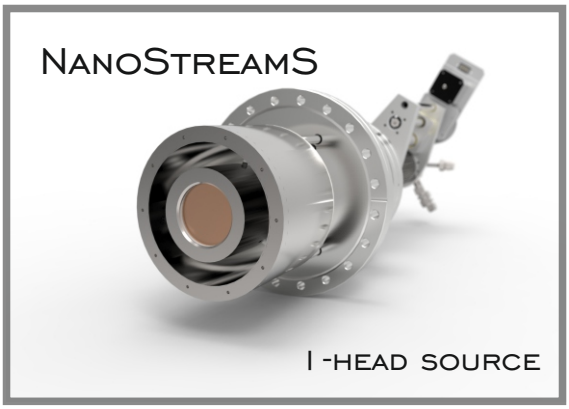
The Product Range - NanoStream

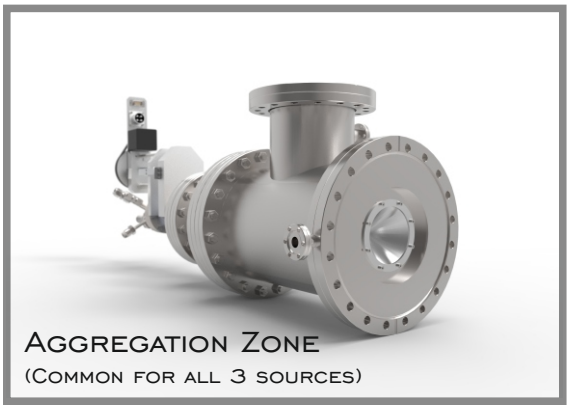
NanoStreamS



1-head source

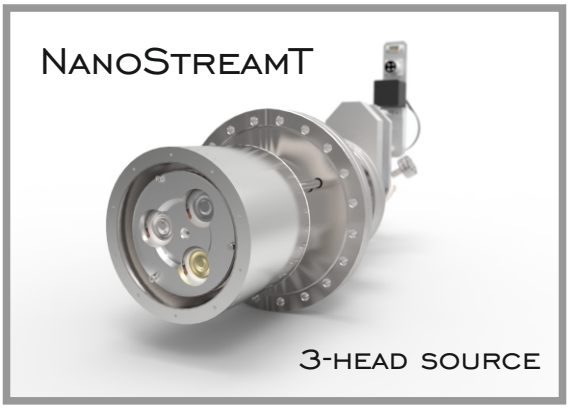
2" targets (0.5-6mm thick)

Single element



Aggregation Zone
(Common for all 3 sources)

NanoStreamT



3-head source

1" targets (0.5-4mm thick)

NanoStreamV

5-head source

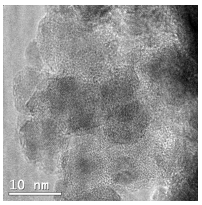
1" targets (0.5-4mm thick)

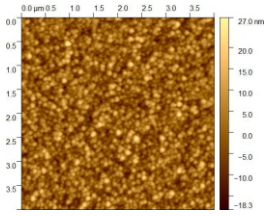
High Entropy Alloy nanoparticles

- Controlled Nanoparticle synthesis
- Oxides/Nitrides (with additional MFC)
- Multi-metal alloys
- Control of Stiochiometry

Size Control

The size of the nanoparticles can be varied by changing the conditions in the aggregation zone. The pressure, power/plasma temperature, distance of the source from the exit and the gas mix will all influence the diameter (and structure) of the nanoparticles





Images courtesy of Professor Alfredo Vilchis Nestor, Universidad Autónoma del Estado de México,

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The Product Range - Accessories

Mass Filter

The MSF quadrupole mass filter can be used in line with the NanoStream sources to analyse and further filter the nanoparticle beam. The mass range extends from 2 amu up to 10^8 amu with an ultimate size resolution of 2% in filtering mode. It is supplied as standard with software control for analysis from a windows-based PC. The MSF can also optionally be equipped with beam focussing and steering electrodes to target either specific areas of a substrate or to scan the beam for large-area coatings.

Core-Shell Coater

The NanoShell core-shell-coater is an optional accessory which can be placed between the NanoStream source and the chamber to allow coating of the nanoparticles with a second (or third) material to form core-shell structures. Internal electrodes increase the residence time in the coating chamber which gives a degree of control over the shell thickness.
Please ask Theris for the dedicated NanoShell brochure for more information.

Full Deposition Systems

Accessories: Full automation, Glovebox Integration, Beam Focus\Steering, Full Deposition Systems

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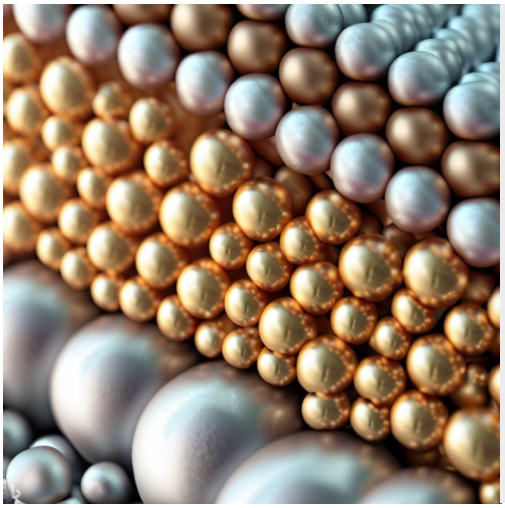
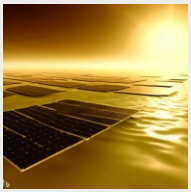
Applications



The combination of features of the NanoStream sources allows multilayers to be deposited with each layer having widely different properties.

- Alternating layers of large and small particles
- Multiple materials in one film
- Compacted films formed by accelerating the nanoparticles into the surface
- Highly porous films with orders of magnitude greater surface area than conventional films
- Nanoparticles embedded in a matrix or solid material

Photovoltaics
Size-selected embedded particles



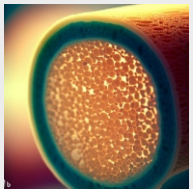
Energy Storage
Nanostructured electrodes

Gas/Liquid Sensors
Highly Specific
Ultra Pure

Catalytic materials
Huge surface area vs solid films

Medical Devices
Nanoporous membranes

Nanoporous films
Tailored porosity
Compacted nanofilms



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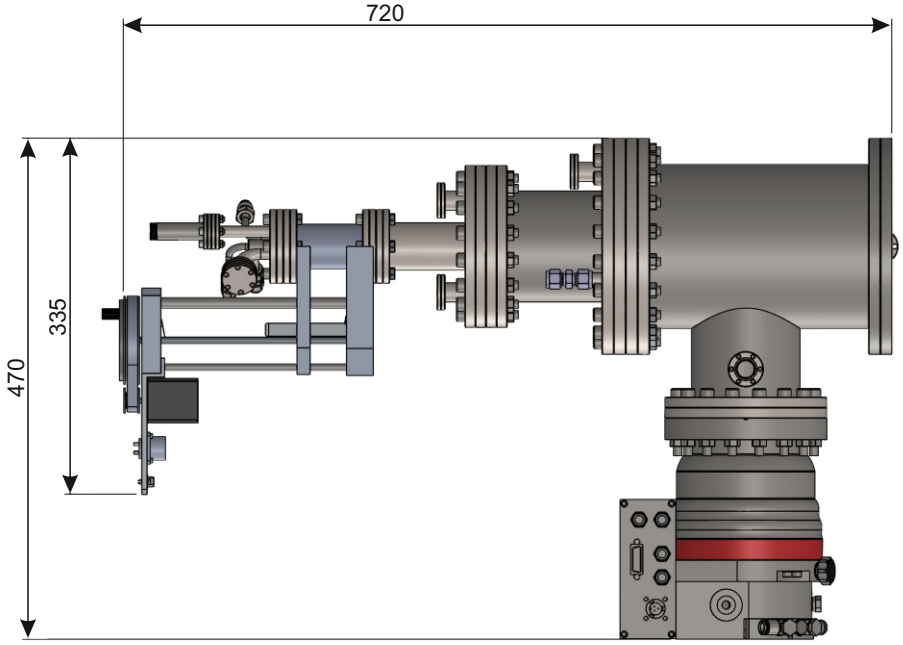
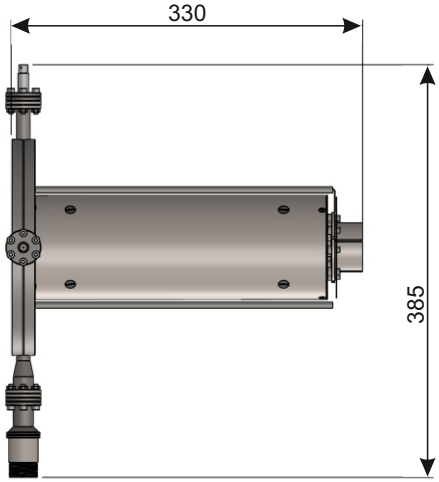
Specifications

NanoStreamS/T/V



MSF Mass Filter



NanoStreamS/T/V	
Mounting Flange	NW150CF
In-vacuum Length	0 mm
NP Size Range	1-20nm typical
NP Size Variation	+/- 15% typical
Cooling	Water/LN2
Gas	Ar. He, N2, 02 optional
Power	110/220V, Max 4kW

MSF Mass Filter	
Mounting Flange	NW150CF
In-vacuum Length	330mm (Optional 0mm)
Measurement range	2-10^8 amu
Resolution	+/- 2%
Power	100/220V, Max 1kW
Control	PC Software Windows 10 or later

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