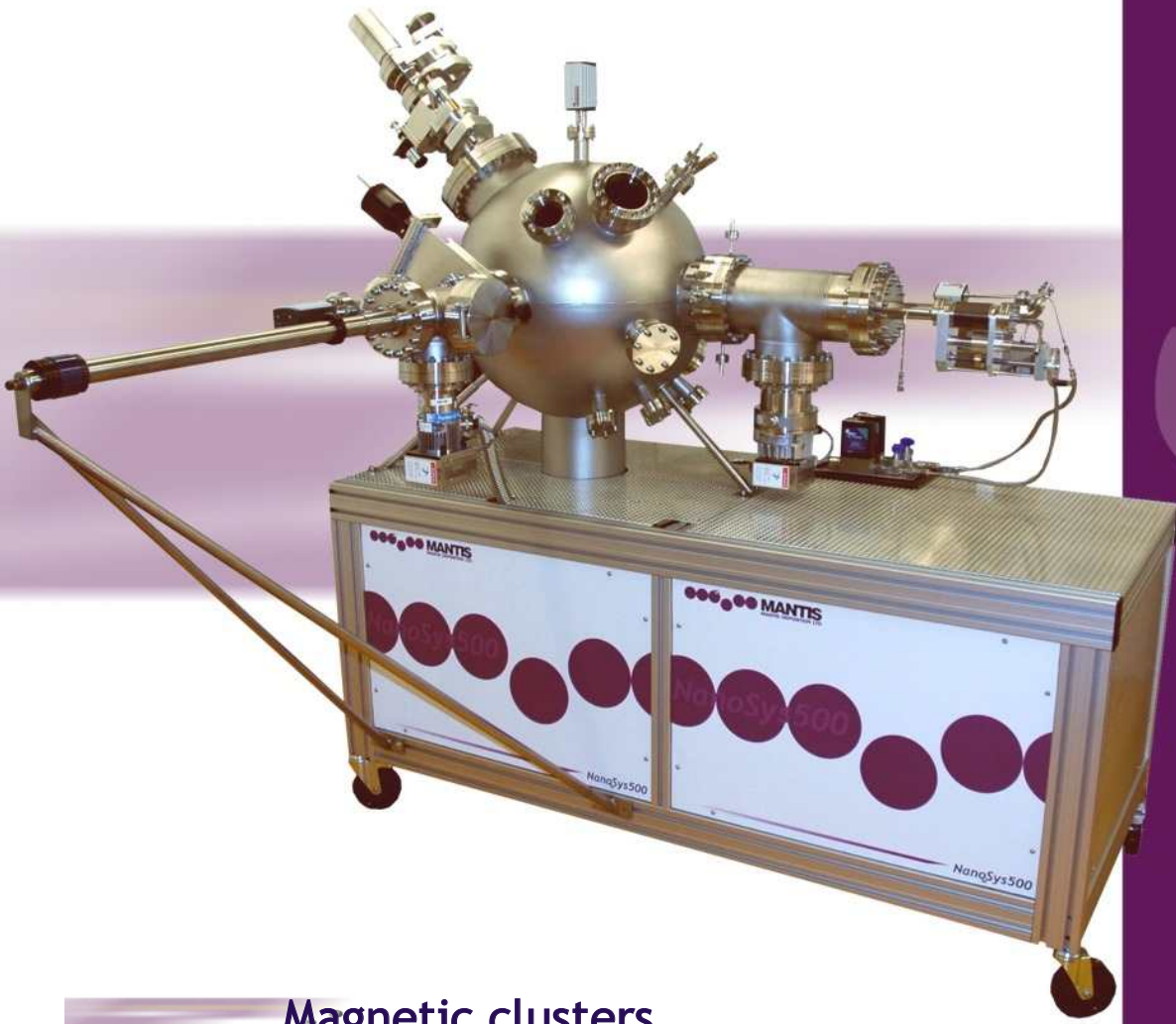


# Nanocluster Deposition Systems

Nanogen50    Nanocluster Source  
MesoQ        Quadrupole mass filter  
NanoSys500    Deposition System

Matrix Encapsulation

Narrow Size distribution



Magnetic clusters

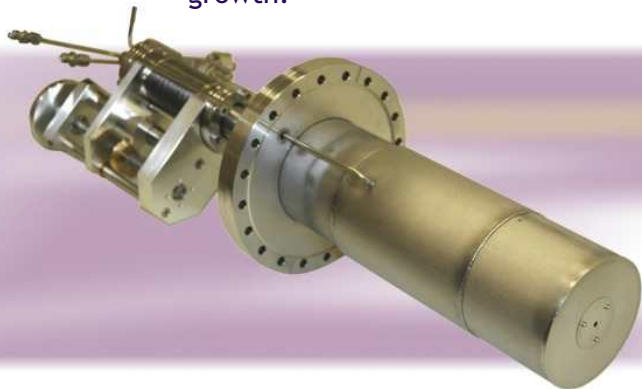
Compound clusters



NanoSys500 Deposition

# NanoSys500 - Depo

At Mantis Deposition we offer a complementary range of instruments for the deposition and characterisation of nanoparticles. Our instruments allow precise beams of size-selected nanoparticles to be generated from almost any elemental or alloy base material. In addition, reactive particle generation allows oxide or nitride compound nanoclusters to be deposited. We can offer instruments for retrofit to existing vacuum chambers or complete system solutions for nanoparticle film growth.



## **NanoGen50 Nanocluster source**

The NanoGen50 nanocluster source uses a unique high-pressure sputtering source to generate nanoparticles within a condensation zone. These nanoparticles emerge from the source in a well-defined beam and can be directed towards a substrate for deposition or encapsulation.

## **Multi-zone refinement**

The gas flow characteristics within the condensation zone ensures refinement of

the size distribution of the beam to allow precise definition of the particle size in the emergent beam. The unique configuration of the condensation zone also maximises the ratio of nanoparticles to carrier gas entering the main deposition chamber. The source can be supplied with user-selectable refinement zones to suit particular applications. Nanoparticles can be generated with as few as 30 atoms up to those with diameters exceeding 15nm.

## **Soft Landing**

Growing particles in the condensation zone undergo numerous collisions with the cold carrier gas in the condensation zone, ensuring that the emerge from the source with low energy. - typically less than 0.1 eV per atom in the nanocluster. This allows 'soft-landing' of the particles in the substrate, which results in the particles retaining their crystalline characteristics. This deposition method lends itself to the fundamental study of nanoparticles or for generating nanoparticulate films of precise characteristics.

## **Energetic Impact**

If magnetron sputtering is used as the vapour generating source, a high degree of nanocluster ionisation can be achieved without recourse to secondary ionisation processes. This allows a significant fraction of the particles to be accelerated

# osition Components

or manipulated. If the clusters are given low to moderate energy, this effect can be used to implant nanoparticles into surfaces for adherent nanoparticulate films. If higher energy is used (upwards of 5eV per atom typically) the nanoparticles spread on impact and form a highly adherent and smooth film on almost any surface. Since the energy is inherent in the nanoparticles, self-annealing takes place without the need for elevated substrate temperatures. This technique can also be used to fill high aspect-ratio holes or vias.

## Compound Nanoclusters

Compound nanoclusters such as oxides or nitrides can be grown by adding a small amount of the reactive gas to the carrier/sputtering gas.

## MesoQ Quadrupole Mass filter/analyser

The MesoQ quadrupole mass filter can be used in-line with the NanoGen-50 to analyse and further filter the nanoparticle beam with



throughput up to  $10^6$  amu. The quadrupole has an ultimate size resolution of 2% in filtering

mode, allowing precise particle size definition to be achieved. When used in conjunction with the Nanogen source, the MesoQ allows high-throughput in filter mode as a high proportion of the beam is naturally ionised. In conventional quadrupole devices, the gases to be

analysed must first be ionised prior to entry into the filter. The MesoQ is supplied as standard with software control for analysis from a windows-based PC.

## Deposition Sources

Mantis can offer additional deposition sources for sample preparation or growth from its selection of in-house deposition instruments or can incorporate sources at the user's request.

**E-beam Evaporators** for thin-film deposition of refractory metals or high-temperature ceramics.

**RF Ion Sources** for etching or assisted deposition. The sources provide a broad, uniform beam in the range 0-1keV with high current density.

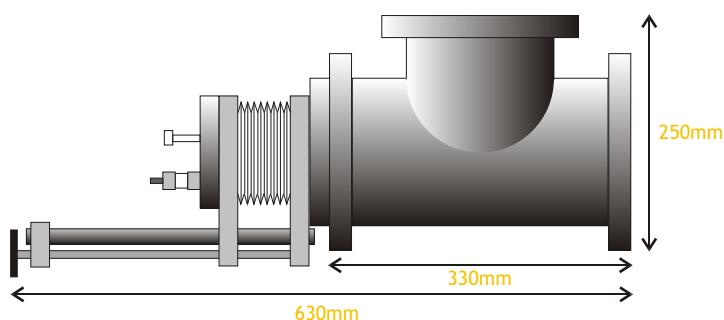
**Atomic Oxygen, nitrogen sources** for generating atomic oxygen or nitrogen for in-situ growth of oxide/nitride films or reaction with the emergent nanoclusters.



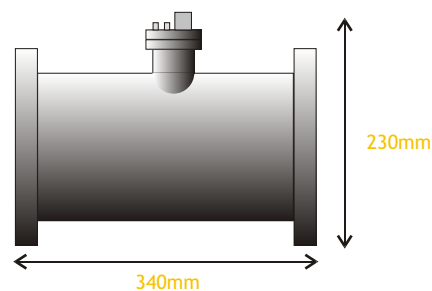
# NanoSys500

## Component Specifications

### Nanogen50



### MesoQ<sub>In-line</sub>



Mounting flange	NW150CF / 8"
In vacuum length	0
Cluster range	1-15nm (material dependent)
Size variation	+/-5% (flow/power dependent)
Deposition rate	6 Angstroms/s (Max.)
Gas flow	5-100 sccm Ar/He
Cooling	Water / Ln2

Mounting flange	NW150CF / 8"
In vacuum length	0
Resolution	~2%
Mass range	2 - 10 <sup>6</sup> a.m.u.
PC Interface	A/D (Software included)

### Accessories

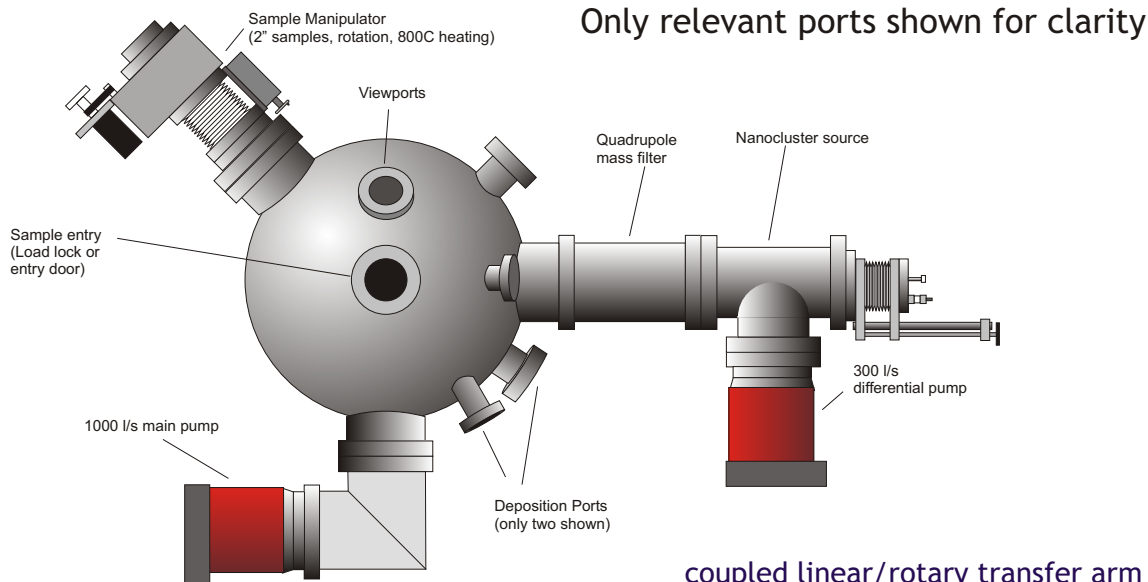
- Full NanoGen Automation** - The NanoGen50 can be offered with full automation including motorised linear feed, power control and gas control. The parameters can be controlled via a PC interface using a standard A/D I/O card for user-defined code. Alternatively, Mantis can supply control software and hardware for PC-based automation. The NanoGen software interfaces with the MesoQ software for a complete solution.
- Beam Steering** - The source can be fitted with beam-steering plates for manipulation of the ionic content of the beam

**OTHER:** Manual Teardrop Shutter, Automated Teardrop Shutter.

*For full specifications of other deposition components, please contact Mantis*

# NanoSys500

## System Description



### Main Chamber

The main chamber in the standard NanoSys500 is of a spherical construction with all port axes passing through the centre-point. The chamber has internal welds and is internally polished to minimise outgassing. Numerous ports are provided for deposition components, with emphasis on below-horizontal alignment to accommodate instruments which use crucibles to contain evaporant, such as effusion cells. The chamber can optionally be equipped with removable cross-contamination shielding in applications where high rates of deposition are required.

*The main chamber design can be configured according to customer requirements*

### Sample Entry

In the basic system, sample entry can be made through a quick-load hinged door (o-ring sealed). For true UHV applications it is necessary to use a sample-entry load lock. The Mantis load-lock uses a magnetically-

coupled linear/rotary transfer arm to transport samples to the main chamber. Optionally, a sample-holder carousel can be included to allow multiple samples to be loaded in the load-lock chamber.

### Sample Manipulator

The NanoSys500 uses a proven sample manipulator with 2" sample capacity, 50 rpm rotation speed, heating up to 800 degrees centigrade and linear movement in the port axis as standard. Additionally, sample bias and unique custom mounting arrangements can be incorporated at customer request.

### System Evacuation

The system uses turbodrag pumps with dry backing pumps as standard, enabling pressures in the low  $10^{-9}$  or  $10^{-10}$  torr to be achieved (after bakeout). Alternative pumping systems can be incorporated at customer request.

### Growth Monitoring

The system can be equipped with a retractable, UHV quartz-crystal monitor to allow accurate determination of the film growth rate at the sample position.

# NanoSys500

## System Specifications

### NanoSys500 (Standard)

<b>Chamber</b>		<b>Other</b>	
Construction	Spherical, UHV	Bakeout	Optional internal
Port focus	Centre of sphere	Electronics	19" cabinet-mounted
Ports	3 x NW200CF 1 x NW150CF 2 x NW100CF 4 x NW63CF 7 x NW35CF	Gauging	Ion Gauge/Pirani 2 - 10 <sup>6</sup> a.m.u.
<b>Pumping</b>		<b>Options</b>	
Main Pump	1000 ls <sup>-1</sup> Turbodrag	Load-lock	
Differential Pump (NanoGen)	300 ls <sup>-1</sup> Turbodrag	Pumping	70 ls <sup>-1</sup> Turbo
Backing Pumps	Dry pumps (scroll)	Mounting	NW100CF
<b>Manipulator</b>		Transfer	Magnetically-coupled transfer arm
Sample Mount	Suitable for 2" samples	<b>Film Monitoring</b>	
Rotation	50 rpm	QCM	UHV-compatible, quartz-crystal monitor
Heating	To 800 °C	<b>Automation</b>	Please contact Mantis for full automation specification
Z-Travel	25mm		

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