



KORVUS TECHNOLOGY

HEX Series

HIGHLY MODULAR PVD SYSTEMS



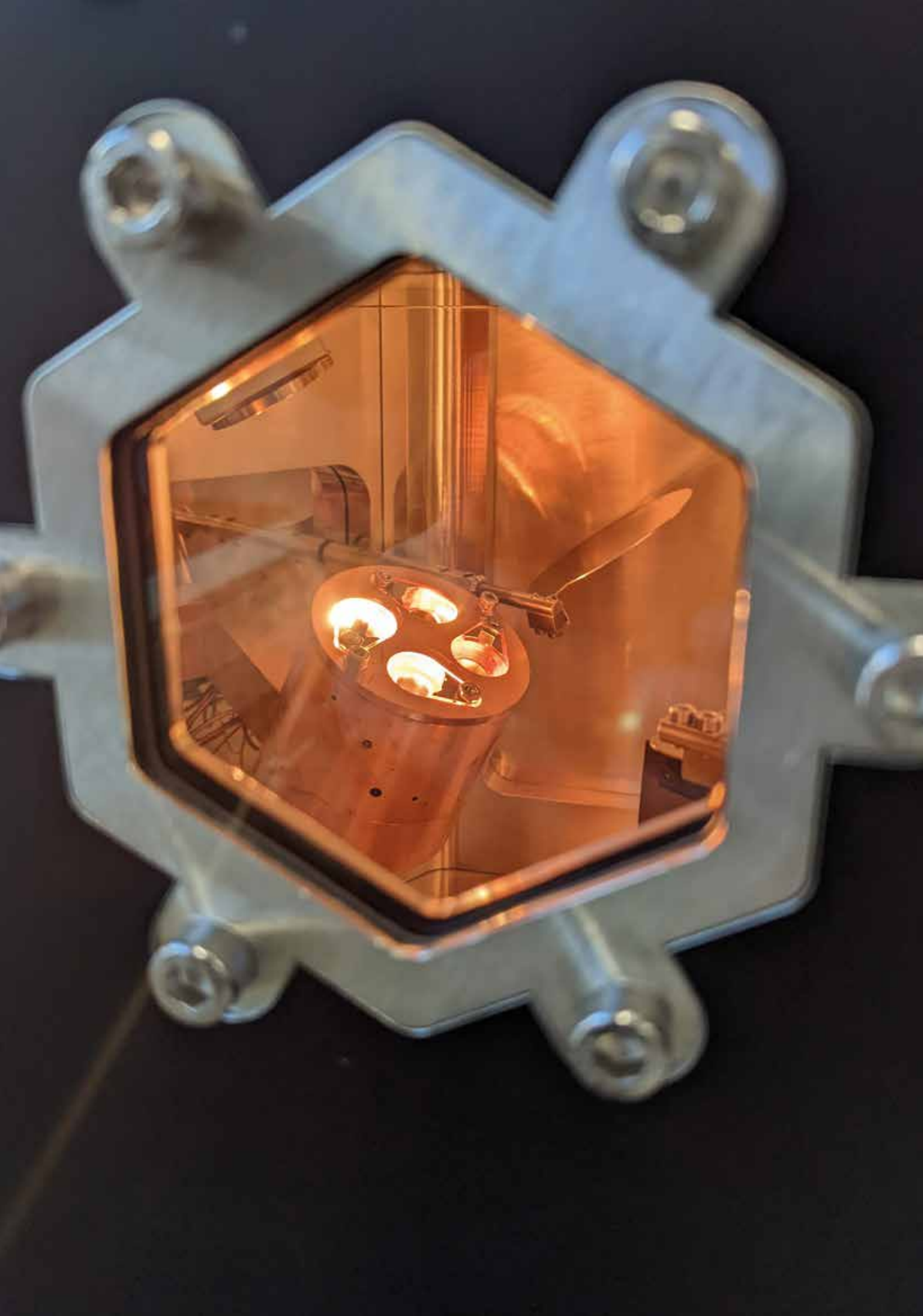
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Welcome to the HEX Series

Highly modular PVD systems with a unique open-frame architecture, offering an unmatched level of user control, customisation and upgradability to researchers in thin-film deposition.

The HEX series of thin film deposition systems provide a versatile range of deposition options for your research.. Starting from the base system, the unit can be later upgraded and customised to different configurations of deposition sources or third-party instruments. These upgrades are modular and simple to install, providing a cost-effective solution while eliminating system downtime. Whatever direction your research takes you in, the HEX Series is by your side.



HEX Series

THE LINEUP

SPECIFICATION



	HEX	HEX-L	HEX-XL
Maximum Sample Size (Diameter)	4"/100mm	6"/150mm	12"/300mm
Number of Deposition Sources	Up to 3	Up to 6	Up to 6
Magnetron Sputter Size (Diameter)	2"	2", 3"	3", 4"
Chamber Volume (Stacked)	12L (24L)	50L (100L)	86L (172L)
Base Pressure (mbar)*	<5 x 10 ⁻⁷	<5 x 10 ⁻⁷	<5 x 10 ⁻⁷
Glovebox Integration	✓	✓	✓
Loadlock Option	✗	✓	✓
Chamber Material	Aluminium or Steel	Aluminium or Steel	Aluminium or Steel

*Ultimate base pressure is on factory tested systems. Subsequent base pressure depends on a variety of factors such as chamber cleanliness, user operation and lab environment.

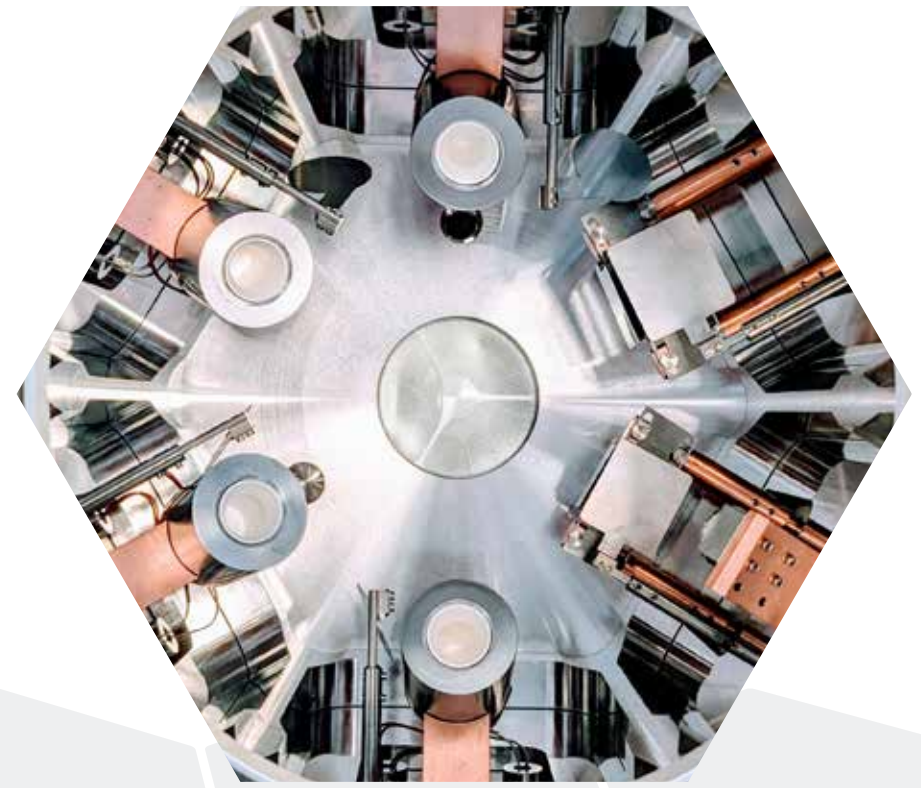
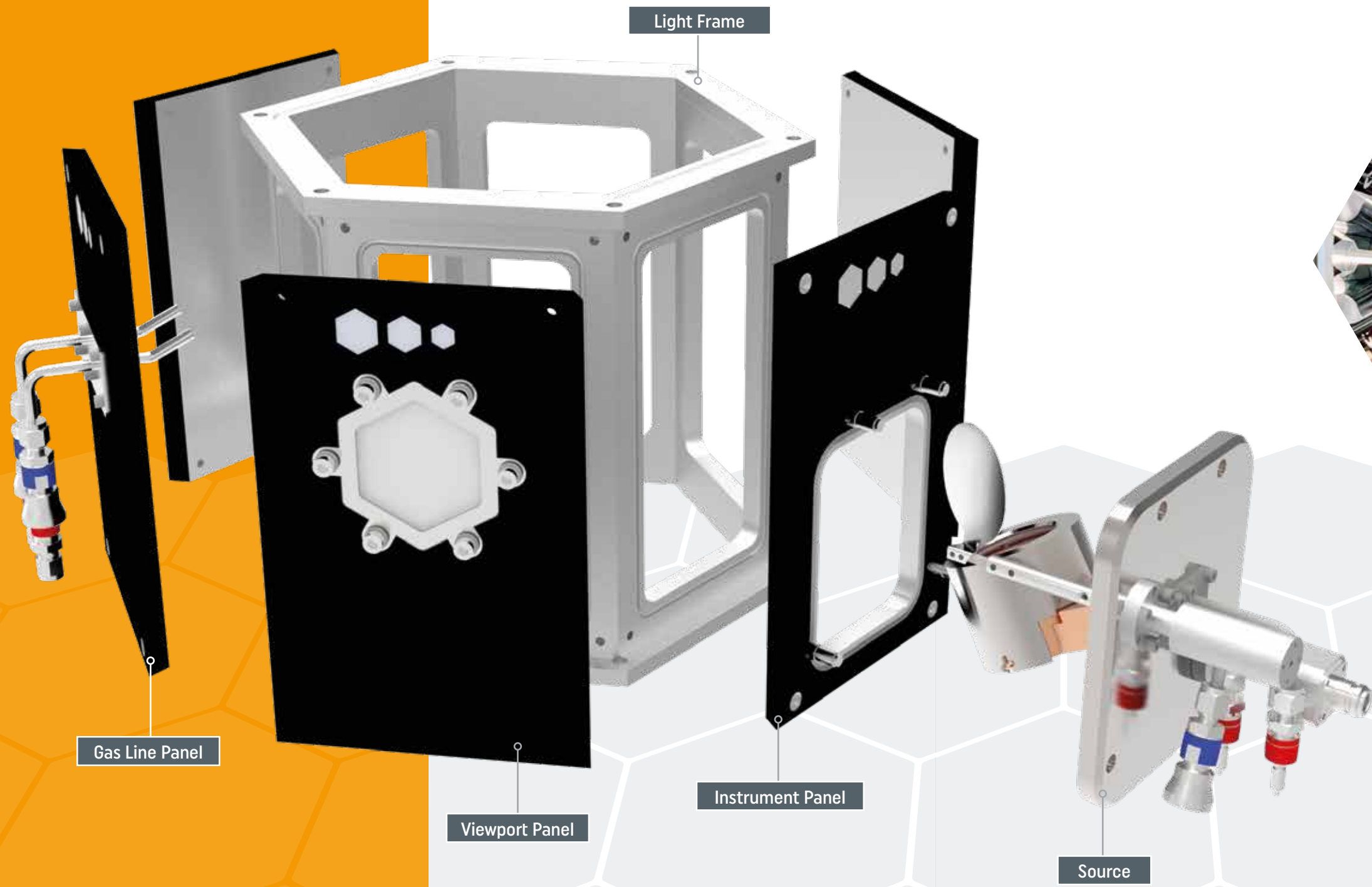
The HEX Series of deposition systems are highly flexible and versatile, offering users the ability to re-configure and upgrade their chambers at will.

ADAPTABLE CHAMBER DESIGN

In contrast to conventional PVD systems which attach instruments using welds, the HEX Series utilises viton gasket o-ring seals almost exclusively. This allows for its ground-breaking open-frame architecture, in which all panels can be removed, interchanged and reattached quickly and efficiently, minimising downtime during system reconfiguration and maintenance procedures. This concept is the bedrock upon which the flexibility of the HEX Series is built.

COMPACT CONVENIENT DESIGN

The HEX Series is benchtop or can be positioned on a portable electronics rack, saving valuable lab space, whereas the HEX-L and HEX-XL sit on a movable frame. This means that all three instruments can be quickly and easily moved around a lab, or between different labs- allowing for flexibility not just in the instruments themselves, but in where and by whom they can be used.



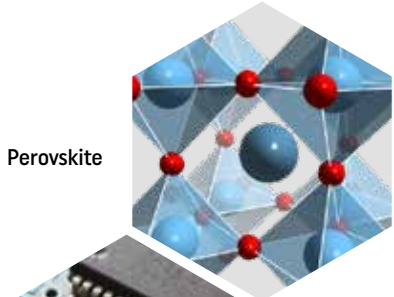
CLUSTER SYSTEMS

Sticking to its modular philosophy, the HEX Cluster allows users to begin with a single chamber, then add subsequent chambers when research demands. This can be done at any point in the system's life, without any reconstruction of the chamber and virtually no downtime.

Application

Cluster systems are vital in applications where contamination between different classes of material must be avoided, while maintaining purity from in-vacuum sample transfer.

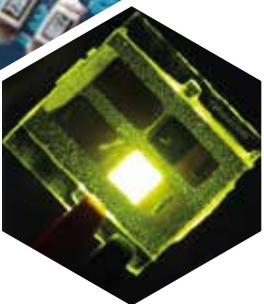
Cluster Type	Number of Chambers	Operation Type
Linear Transfer Cluster	Up to 3	Manual
Robotic Transfer Cluster	Up to 6	Automatic



Perovskite

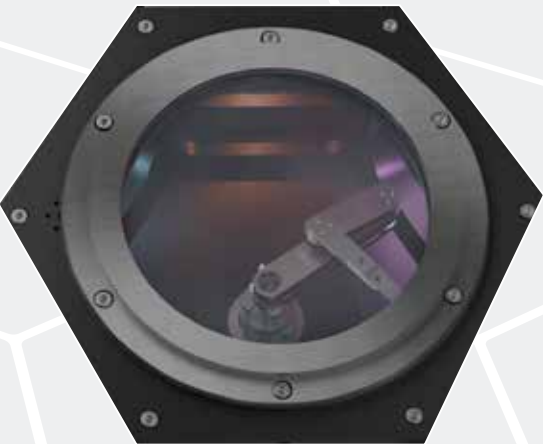


Semiconductors



OLED

Robotic Transfer Arm in Antechamber



The Robotic Transfer Cluster uses a Korvus-designed-and-built robotic arm for effortless transfer between multiple chambers from a central antechamber.



The Linear Transfer Cluster utilises a **UHVD** transfer arm for seamless and cost-effective exchange of wafers between chambers.

CUSTOMISE WITH EASE

Seamless integration of third-party instruments

HEX series panels are easily changed, allowing for the modification of the vacuum chamber. This unique feature enables easy addition of any instrument after initial system purchase, eliminating costly design work, engineer visits, and system downtime.

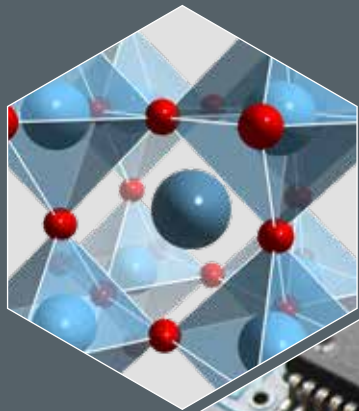


The HEX series offers an unrivalled ability to be customised

With its unique modular design, the HEX series offers the ability to integrate a range of third-party deposition and analytical techniques. This provides unparalleled options for modification and enhancement.

HEX-L with THERIS Nanoparticle Deposition Source

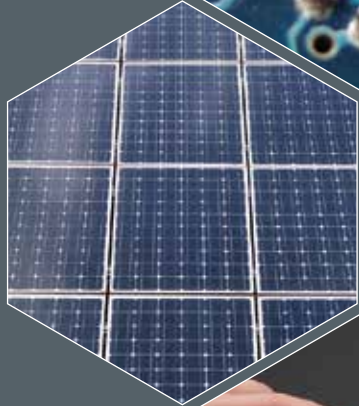




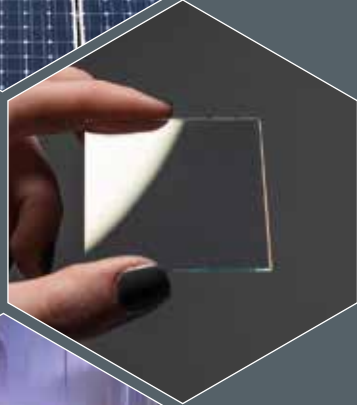
Perovskite research



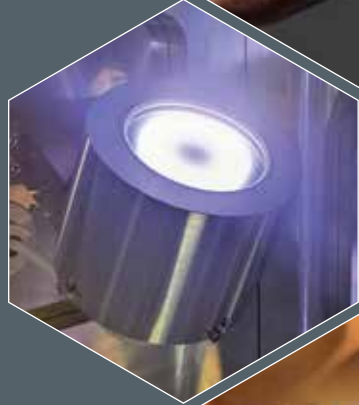
Research and development of new coatings



Solar cells, semiconductor and battery R&D



Optical coatings



Sputter deposition



Teaching and training

APPLICATION

The unique open-frame design and flexibility of the HEX make it a powerful platform for a range of applications; including solar research, semiconductor applications and teaching.

FUTURE-PROOF

COMPLETE FLEXIBILITY IN YOUR PROCESS

Stack it

Stack your HEX series at any point in its life to optimise process parameters when longer throw distance is needed

Chamber	Single Chamber/ Stacked Volume	Max Throw Distance: Single/Stacked
HEX	12L/24L	12cm/~45cm
HEX-L	50L/100L	24 cm/~60cm
HEX-XL	115L/172L	24 cm/~60cm

Upgrade or Modify with Ease

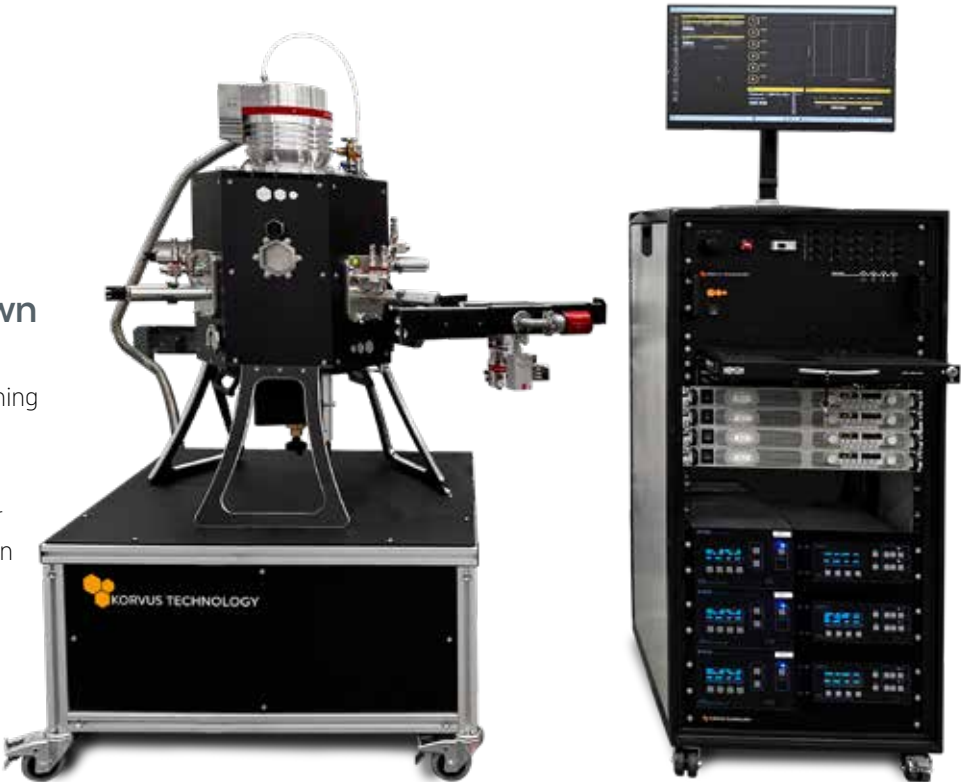
Add sources at any point in the systems life without needing engineer visits or system downtime.



Sputter up or Sputter down

The HEX Series can be placed in a sputter down or sputter up configuration by switching the detachable top and bottom plates.

Sputter up can be useful for evaporative methods and reducing dust, while sputter down completely eliminates shadowing on heavier samples..



Source to Substrate Distance and Angle

Utilise the HEX Series' modularity to change source-sample distance and angle at will. This gives users complete control over their process parameters, useful for optimising uniformity, deposition angle and thermal load on the substrate.



RELIABLE DEPOSITION SOURCES

FISSION MAGNETRON SPUTTERING SOURCE

Designed for 2" diameter targets, the sputter sources are equipped with SmCo magnets and accept targets with thickness ranging from 0.5 to 6.5mm of non-magnetic materials and up to 2mm for magnetic materials.

The sources can be used with DC, RF, pulsed DC or HIPIMS power supplies.



ORCA ORGANIC MATERIAL DEPOSITION SOURCE

The ORCA organic deposition source facilitates stable operation between 50 and 600°C. Sensitive organic materials can be evaporated with precise control due to water-cooling and temperature feedback loop.



TAU E-BEAM EVAPORATOR (METALS)

Our high-accuracy mini E-beam evaporators are ideal for ultra-thin film deposition of metals with reliable process control.

The TAU is a four-pocket source, providing multi-deposition options in one.

The control electronics allows up to four sources/pockets to be operated simultaneously.

Material can be evaporated from rods or material held in a crucible.



TES THERMAL BOAT SOURCE

The thermal boat source allows for the integration of a range of thermal boats for the deposition of both metals and organics/polymers. A cost effective source.



CUSTOMISABLE SAMPLE STAGE

EFFICIENT SAMPLE EXCHANGE

The sample stage is fitted with two ergonomic handles for easy transfer to and from the chamber.



ROTATING STAGE

Optional RF or DC bias



ROTATING HEATING STAGE

Temperature: 100-500°C
(800°C-1000°C options available)



ROTATING COOLING STAGE

Water Cooled: Active and passive options.



TAU

ELECTRON BEAM EVAPORATION SOURCE

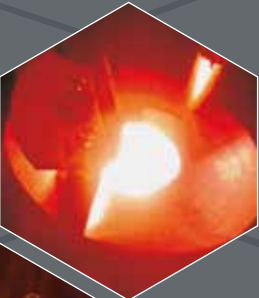
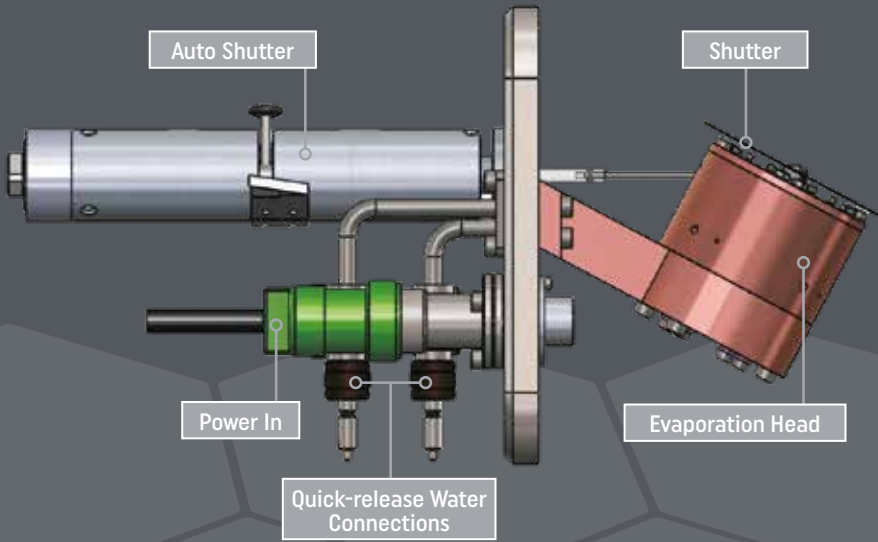
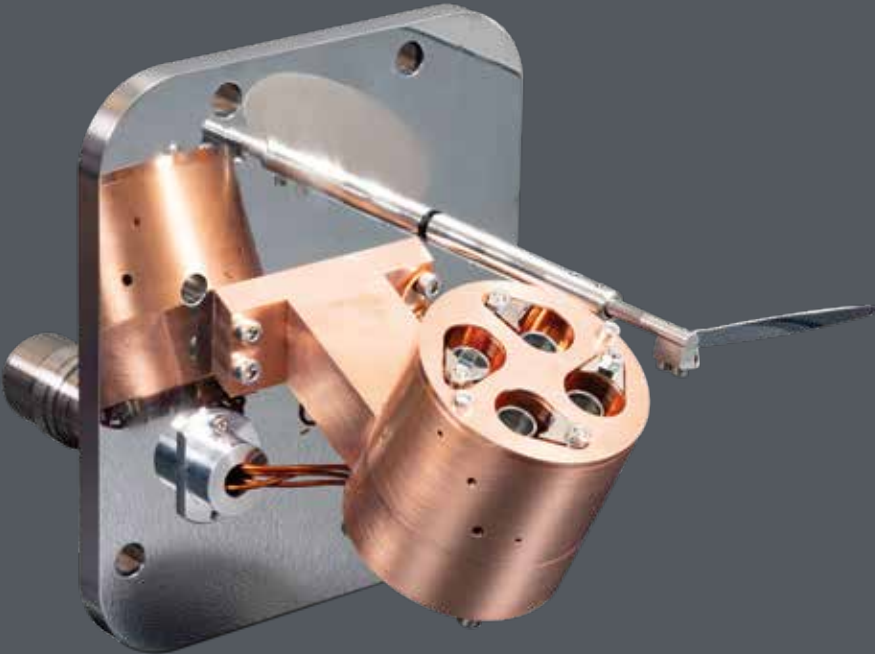
Electron-beam evaporation is a direct heating evaporation method in which a beam of electrons is targeted at the evaporation material. This allows for high temperature operation that is capable of evaporating even the toughest of materials, such as refractories like tungsten.

Alternative thermal evaporation techniques employ radiative or resistive heating that limit achievable evaporation temperatures due to thermal losses from the transfer of heat from the heating element to the evaporation material. In an e-beam source, a high energy electron beam is directed at the target material and produces much higher heat.

The TAU evaporator is a mini source, which places the evaporation material at a high voltage relative to the heated emission filament. This type of source alleviates the need for bending magnets, which greatly increase the size of a source.

This source accepts either rods of conductive material, or can be used with crucibles to hold non conductive materials as well as pellets or powders. Each full pocket can deposit a film of a few microns.

The TAU source uses an enclosed, water-cooled head, ensuring that the thermal load of the source onto the chamber is reduced to a minimum. This allows the TAU to be used for evaporation onto sensitive substrates, and facilitates efficient use of expensive source materials (like gold) when evaporated from a collimated crucible.



Metallisation
Lift-off process
Refractory
materials



Co-evaporation
of up to 4 materials

	TAU-4
Pockets	4
Maximum Power Per Pocket	250W
Materials	Rods (max 4mm dia), Crucible (1 or 2 cc)
Co-evaporation	Yes
Cooling	Water (min 0.5l/min)

TES

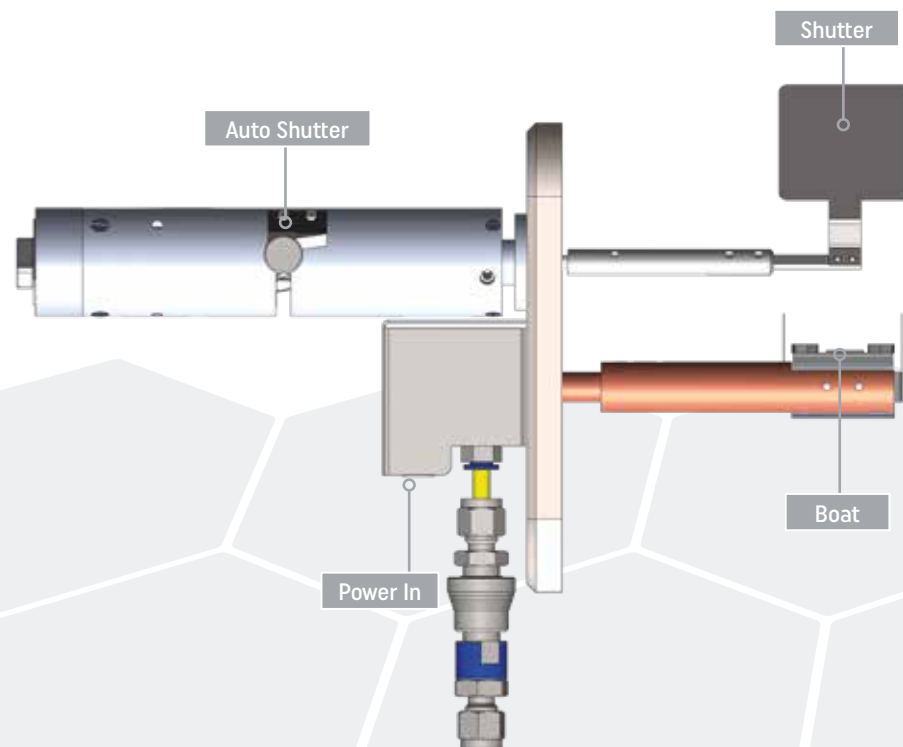
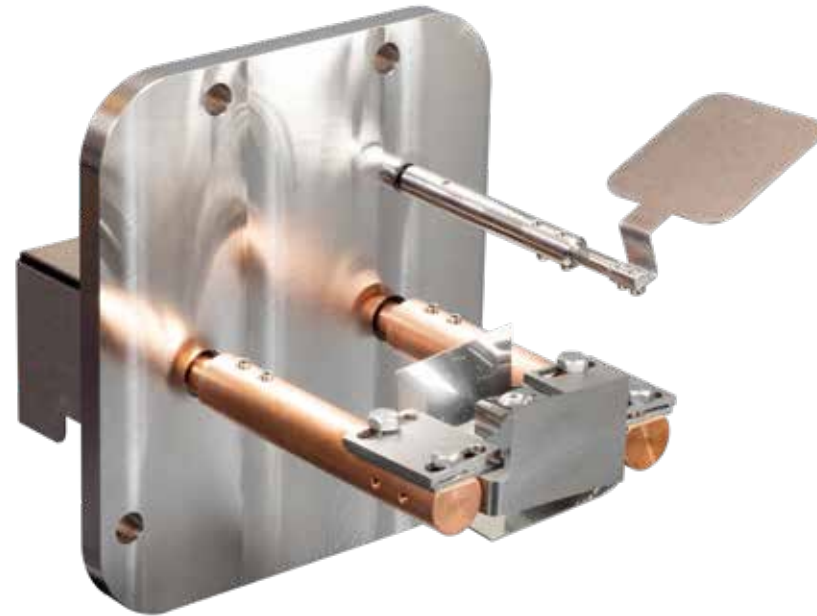
THERMAL EVAPORATION SOURCE

Thermal evaporation sources are used for basic thin film deposition processes. The evaporant material is placed in a conductive boat and is heated by passing a high electrical current through it. As the temperature of the boat rises, the material in the boat begins to evaporate. The temperature, and hence the evaporation rate of the material, is controlled by the amount of current applied.

Advantageously, thermal evaporation requires no process gas so the process can be performed under very high vacuum conditions resulting in very few impurities being incorporated into the deposited films.

The evaporant material can be replenished through quick removal of the source or via the top of the chamber through a reloading tube. Material can be in the form of pellets, powder or coated coils/filaments. Boats and filaments can also be easily and efficiently replaced.

Each source can be equipped with a manual or automatic shutter. Up to three sources can be accommodated in the HEX chamber and up to six in the HEX-L. The sources can also be used in conjunction with other techniques such as sputter deposition, e-beam deposition and low-temperature sources.



Boat Volume	1cc to 5cc
Temperature Range	50-2200°C (material dependent)
Power Supply	DC, 1.2kW



Simple Operation
Water Cooled



Contact
metallisation
AR coatings

FISSION

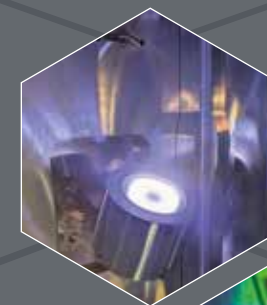
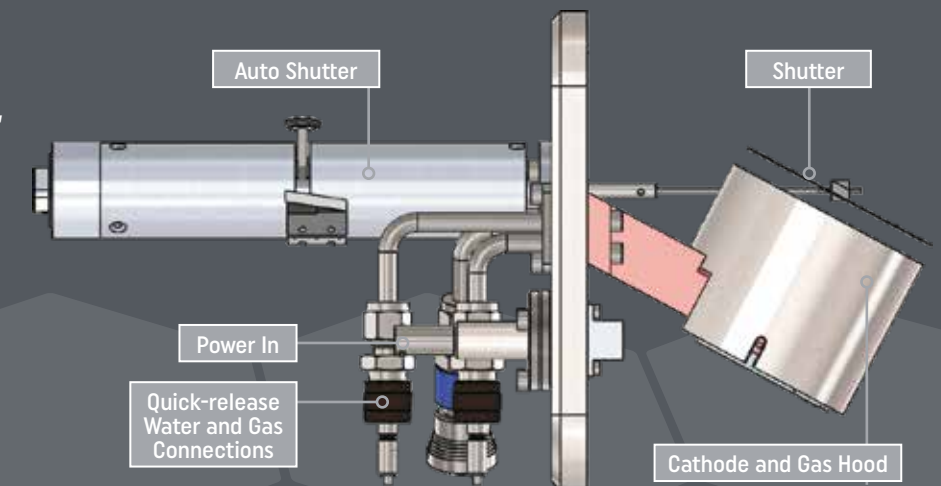
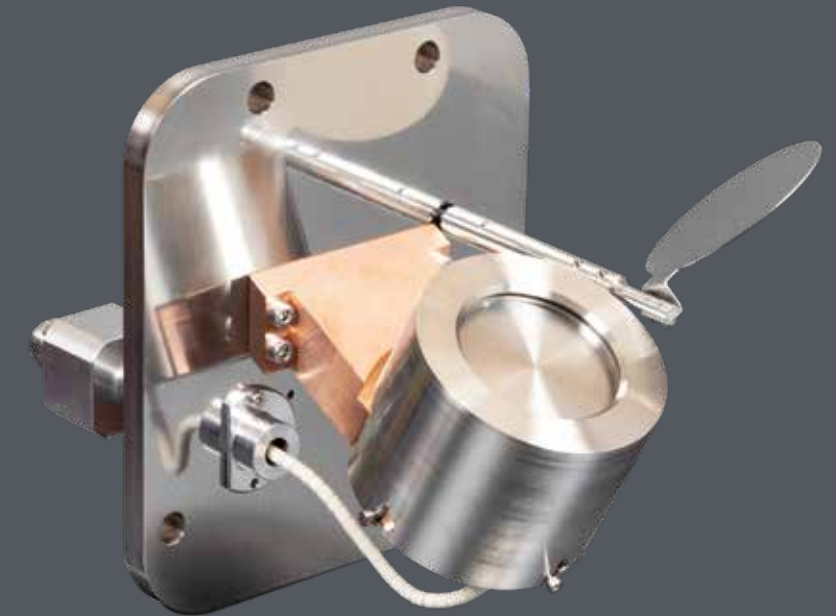
MAGNETRON SPUTTERING SOURCE

Sputter deposition is a widely-used technique for the deposition of thin films. A plasma is ignited above a negatively biased 'target' which has the effect that ions are drawn from the plasma and accelerated towards the target material. On impact, the argon ions eject atoms/molecules from the surface - a process known as sputtering. The sputtered material forms a vapour, which re-condenses on a substrate to form a thin film.

The Fission magnetron sputtering source enables rapid, contaminant-free deposition of metal or dielectric films. Water-cooling and gas connections are made using quick-release connectors to dismount the source, and eliminating the hazard and inconvenience of draining coolant-water each time the source is removed from the chamber.

The Fission source can be operated with DC, RF, Pulsed DC and HiPIMS supplies. Gas introduction is through the gas hood, allowing a higher partial pressure to be achieved near the target surface and thereby reducing the overall chamber pressure required during deposition.

The Fission source can be used to sputter all (solid) metals, insulators and semiconductors. Multiple sources may be used in one system in order to grow multilayer or composite material films.



RF/DC Sputtering
High target usage

Metallisation
Dielectric films
Multilayers



Target Diameter	50mm (2") 75mm (3"), 100mm (4")
Maximum Target Thickness	6.5mm (2mm magnetics with strong magnets)
DC Power Supply	780W (600V, 1.3A)
RF Power Supply	300W (13.56MHz)
Cooling	Water (min 0.5l/min)

ORCA

ORGANIC EVAPORATION SOURCE

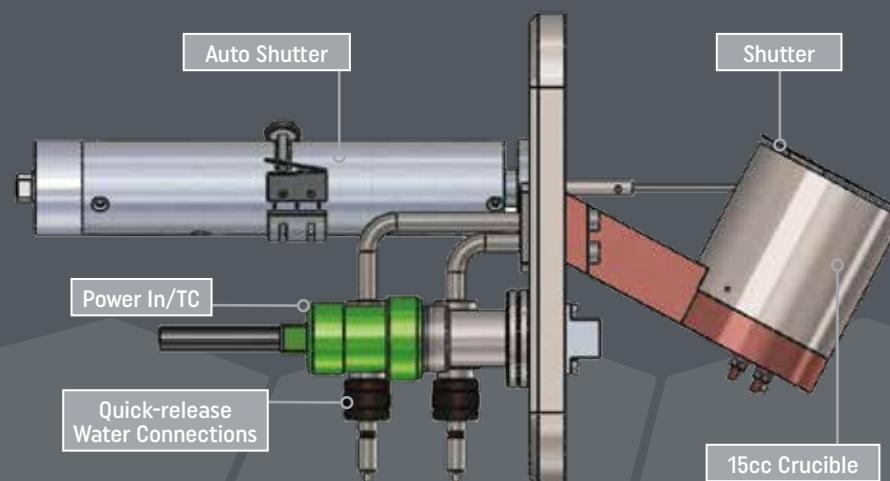
The evaporation of materials at low temperature (50-600°C) requires specialised sources which are designed to operate in this range. Conventional evaporation sources are built to operate most efficiently at temperatures >1000°C which requires that conductive thermal losses are kept to a minimum. At lower temperatures, control loops in conventional cells suffer from overshoot and slow temperature change.

The ORCA low-temperature evaporation source employs active cooling of the crucible to ensure that the heating process is balanced by a strong opposing cooling process which results in exceptional temperature stability and control.

The crucible is constructed from high thermal-conductivity material, ensuring no hot-spots arise which could distort the evaporation rate. Optionally, alumina or graphite liners may be employed. The crucible is easily removed/swapped without the need for tools, although this is often not necessary since access to the source in order to refill the crucible is efficient and simple.

The K-type thermocouple is inserted into the body of the crucible, giving more accurate readings in comparison to typical touch-contact arrangements.

The source may be used in conjunction with e-beam, thermal or sputtering sources. Thermal cross-talk is kept to a minimum through the cooled shielding cap.



Crucible Volume	5cc-15cc
Temperature Range	50-600° C
Thermocouple	type K
Power Supply	DC
Cooling	Water (min 0.5l/min)

Organics
Deposition
OLED Devices



Active Cooling
Accurate
Temperature
Control
High stability



SAMPLE STAGE

Selecting the correct sample stage for a specific application is as important as choosing the correct deposition method. The features of the sample stage can affect the uniformity, the morphology and the resulting film composition.

The HEX series can be equipped with stages ranging from 4" to 12" depending on customer requirements and application. All sample stages can be equipped with either a manual or a motor-driven automatic shutter. The system features a convenient set of mounting posts to secure the stage when replacing samples without needing to clear additional work space.

Sample Rotation

The stage may be upgraded to magnetically operated sample rotation. The rotation (0, 5- 28rpm as standard) improves the film uniformity and is recommended for samples with dimensions greater than 15mm and/or where good uniformity is important.

Bias Table



Optional sample table bias can be used for soft substrate pre-cleaning (RF) or to change the properties of your film.

Options

- 5-28rpm
- DC or RF
- Manual or Automatic sample Shutter

Sample Heating

The rotating stage has options for heating to 500°C - 800°C which will result in improved film morphology for some materials during deposition or for post-annealing.

Rotating/Heating Table



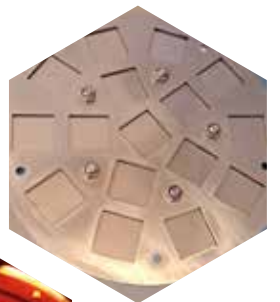
The rotating (and optional heating) sample stage dramatically improves deposition uniformity and is recommended for samples >15mm

- 5-28rpm rotation
- K-type thermocouple

Options

- 500°C - 800°C heating option
- Bias option
- Manual or Automatic Sample Shutter

Customisable Sample
Holder Plate

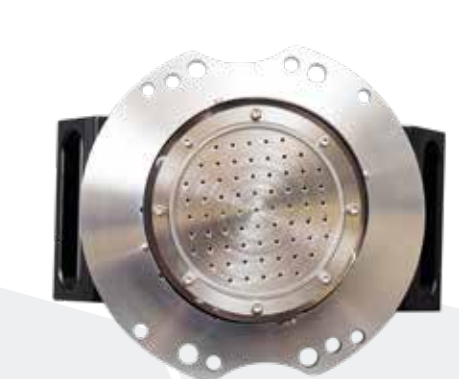


Heating
underneath:
4" Sample Stage
Rotating Heating

Sample Cooling

A rotating water-cooled or cryogenic gradient sample stage can be employed to reduce unwanted uncontrolled temperature-rise in sensitive samples such as during the coating stage in lift-off processes.

Cooled Table



The water-cooled or cryogenic stage allow temperature-sensitive samples to be coated without danger of thermally-induced damage. Control is either active or passive.

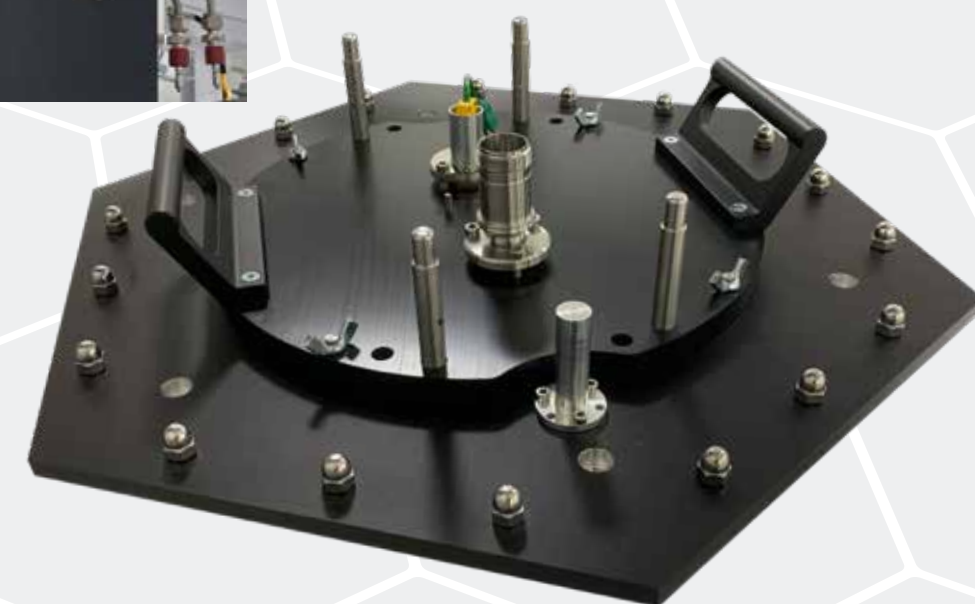
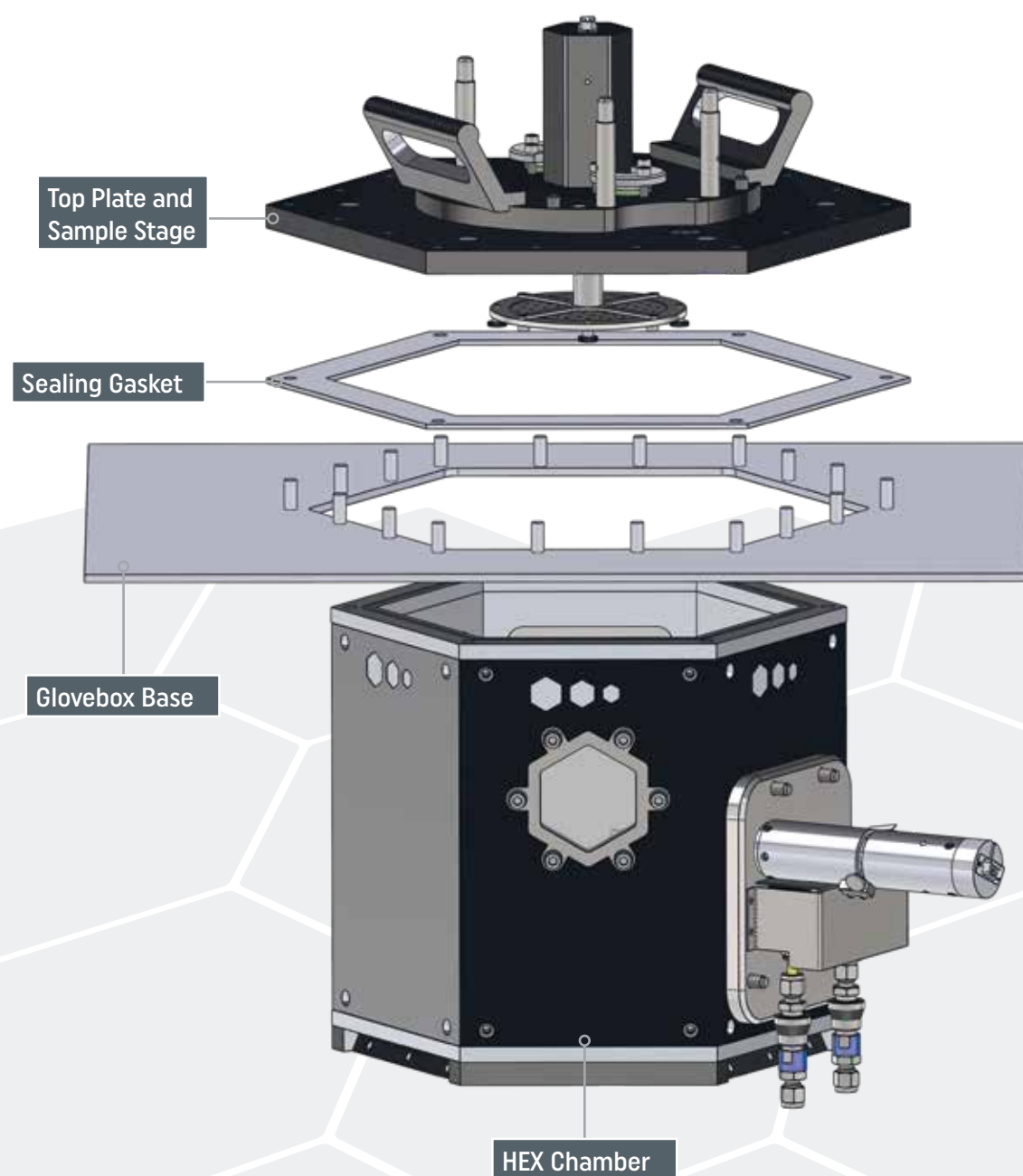
Options

- 5-28rpm rotation
- Manual or Automatic Sample Shutter

GLOVEBOX INTEGRATION

The HEX series is ideally suited to air-sensitive research applications that require a glovebox, such as battery R&D. The integration solution offers two key advantages. Firstly, the system occupies minimal space in the glovebox itself, allowing use for other purposes. Secondly, as the chamber sits below the glovebox, the system is easily accessible for cleaning and modification.

The HEX, HEX-L and HEX-XL are glovebox compatible, and integration can take place at any time as research requirements develop. Both models occupy almost zero space within the glovebox itself-providing researchers a elegant solution to the problem of evaporating organic and air-sensitive materials.



NIOBIUM

AUTOMATION SOFTWARE

OVERVIEW

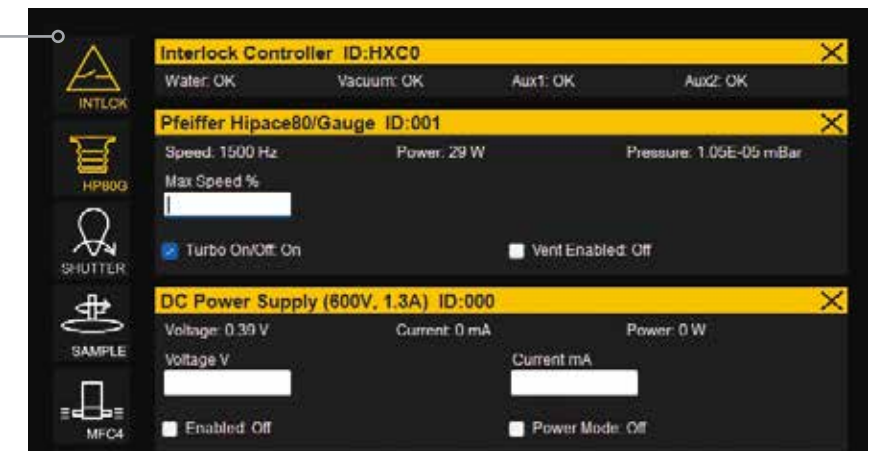
The Niobium Automation software package allows the user full control over the HEX deposition system and components. The full data-set is automatically logged, charting of multiple parameters is possible and sophisticated process programming is enabled via step based procedures including looping and conditional options.



Modular software design allows easy addition of control units when upgrading the system. Our proprietary software facilitates the addition of Korvus-manufactured, as well as third-party components to your HEX, HEX-L or HEX-XL.

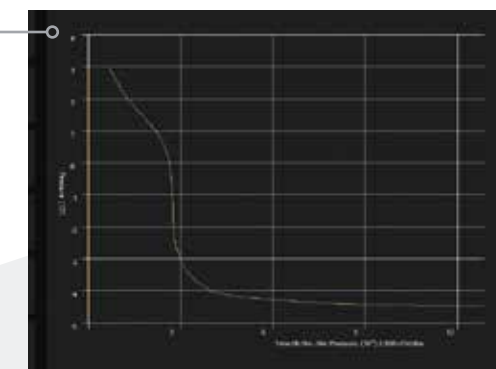
Instrument Control

- Connected electronics units are represented by icons, which are clicked to show or hide the detailed parameter set for the unit
- All parameters can be renamed by the user



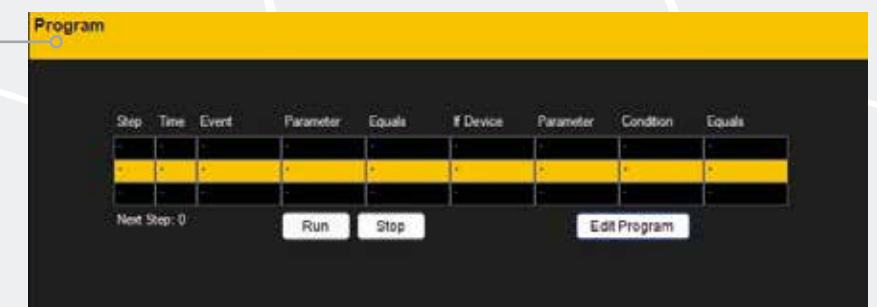
Charting/Logging

- Multiple parameters can be charted simultaneously.
- Autoscaling and zoom functions
- Automatic logging of all system parameters into a CSV file



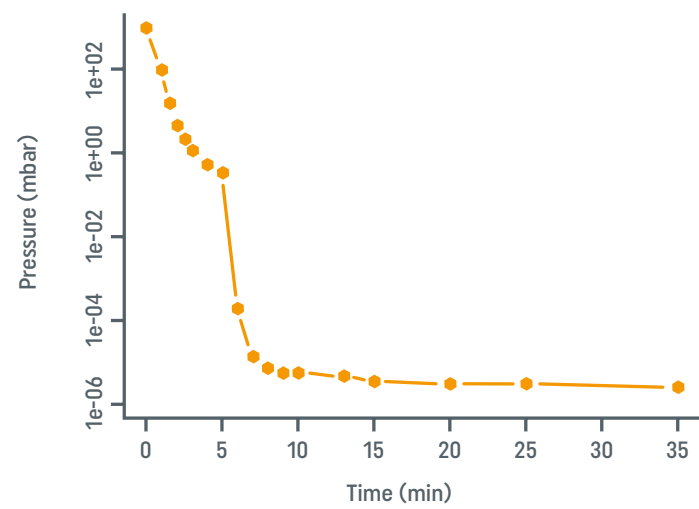
Programming

- Programming of deposition processes via time-based event procedures
- Programs can be stored and incorporated into new programs
- Looping allows repetition of processes
- Conditional programming allows steps to complete only if certain conditions are met. For example, a source shutter can be closed when the measured film thickness on a QCM is above a certain value



RAPID PUMP DOWN

HEX pump down curve with 300L/s turbo pump



The HEX system is shipped as standard with an 80L/s turbo pump (optional 300 upgrade), the HEX-L standard is a 300L/s turbo (optional 700L/s upgrade), and the HEX-XL is 700L/s (optional 1200L/s upgrade). All are backed by oil-free pumps and pressure is measured by a full-range gauge.

The low chamber volume allows rapid pumpdown, with operational pressure (10^{-6} mbar) for typical applications being reached in less than 10 minutes.

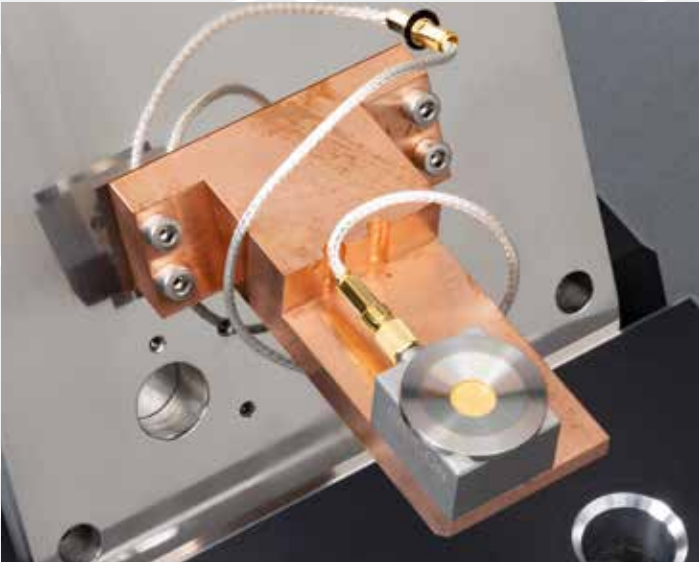
The system base pressure is 5×10^{-7} mbar, although with routine system maintenance, lower pressures are commonly reached.

Times to get down to mid/low 10^{-6} mbar.	
HEX 80	30-40 mins, venting in <10 mins
HEX 300	20-30 mins, venting <10 mins
HEX-L 300	30-40 mins, venting 20 mins
HEX-L 700	20-30 mins, venting 20 mins
HEX-XL 700	30-40 mins, venting 20 mins
HEX-XL 1200	20-30 mins, venting 20 mins

ACCESSORIES

THIN FILM THICKNESS MONITOR

Film deposition rate and thickness can be determined with the use of a quartz-crystal monitor (QCM) which uses the change in resonant oscillation frequency of a thin quartz crystal.

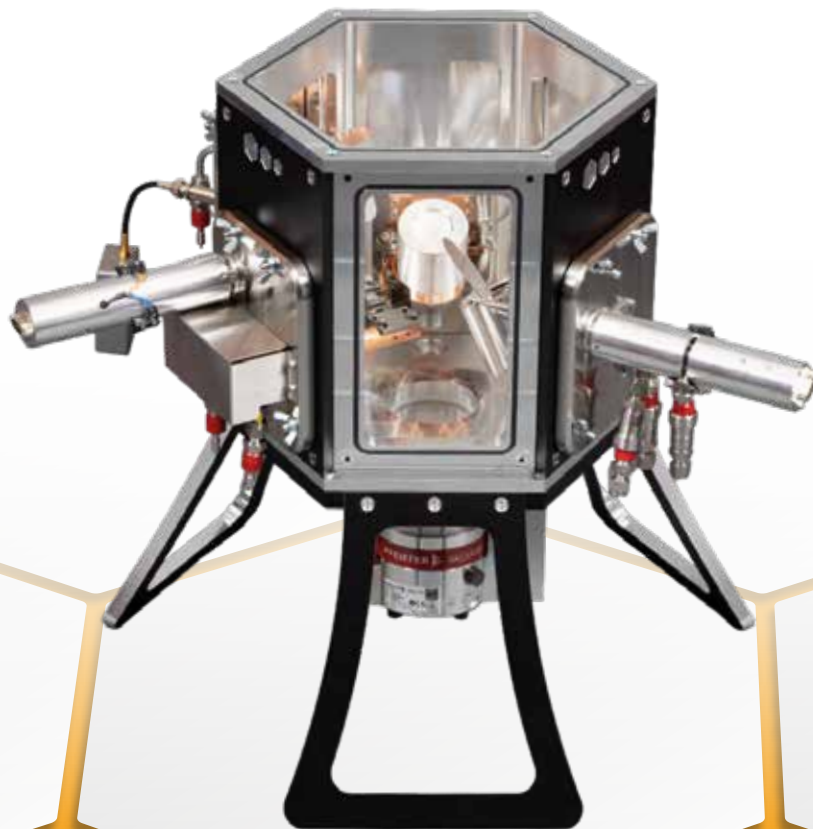


LOAD-LOCK SAMPLE TRANSFER

The HEX-L and HEX-XL Platforms allow for easy integration of a loadlock transfer arm, which allows for much higher throughput and lower pumpdown times.



Korvus Technology has over 20 years' experience in the high and ultra-high vacuum sector. With over 150 HEX Series systems installed worldwide, Korvus Technology remains at the forefront of the PVD industry. Korvus is now part of the Judges Scientific group, while remaining an autonomous company. This allows Korvus to remain agile to the research challenges of its customers and continue its customer focused culture.



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