OXFORD APPLIED RESEARCH

High dissociation

High quality films

Uniform coverage

Nitrides, Oxides, N-doping,
Hydrogen atom cleaning...

RF Atom Sources

RF Atom Sources

Ultra-high efficiency - Zero ion Current - High quality films

The HD series is built on the extensive experience of Oxford Applied Research in supplying RF atom sources to the scientific community. The latest range of models produce a neutral beam with a extremely high atomic flux and zero ion content. The atoms have merely thermal energies and yet are highly reactive. This allows the rapid growth of extremely high quality materials free of the point defects associated with ion beam processing. Our sources are furthermore designed to be versatile, allowing changes between different gases and flow regimes to be accomplished simply by the user.

Application areas

The RF atom sources from Oxford Applied Research are employed in a wide variety of thin film processes in both research and fully-automated production applications. The thermal characteristics of the reactive beam ensure rapid delivery of atomic species to the substrate without the detrimental consequences of high energy processes. This makes the sources ideal for the growth of high quality nitrides and oxides, and for low-damage cleaning using atomic hydrogen. The sources are used with great success in applications such as GaInNAs, GaN, ZnO, ultra-thin Al_2O_3 films and high-k dielectric oxides.

Principle of Operation

In RF atom sources a gas, such as nitrogen, is introduced into an all-ceramic cavity (discharge zone). A plasma is induced in the discharge zone by applying inductively-coupled RF excitation. The plasma dissociates the feed gas into ions and neutral reactive atoms, the latter species effusing through an apertured, plasma-confinement plate into the process chamber. Charged particles are retained within the plasma.

The sources include highly efficient water cooling to ensure minimal contamination during operation. They also have magnetic confinement of the plasma for enhanced cracking efficiency, and an ultra efficient matching network which demonstrates almost zero power loss at maximum operating power.

Zero Ion Content

For many applications the presence of even 0.01% ion content in the beam can so change the properties of the material being grown as to render it useless for its intended application. The HD series includes a number of unique design features which completely eliminate charged particles from the atom flux.

Beam Shaping

As various applications mature to production processes, uniformity of the atomic flux becomes a pivotal issue. All our RF sources are now available with beam shaping of the atomic flux to permit high uniformity over a large area. This technique can be adapted to offer optimum uniformity on all commercial growth systems, allowing specimens of >12" in diameter to be processed.

Versatile - <0.01 to 100sccm - Full automation possible

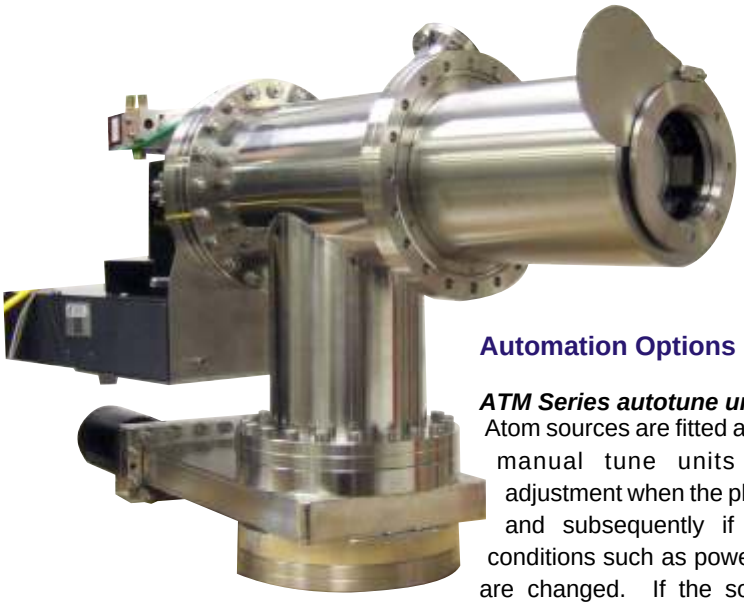
Atom Source Options

Teardrop shutter - TDS1

A manually operated shutter is available for users without this facility on their vacuum chambers. The shutter is of the rotary teardrop type, and is mounted directly on the end of the source.

Air-drive & Solenoid Shutters

A compressed air-driven actuator is available for the tear drop shutter with electronic position sensors and control valve with manual override facility. An electrically driven solenoid actuator is also available as an option.



Differential Pumping

Our HD20,25 & 60 sources can be supplied fitted inside a differentially pumped tube with integral shutter. In this way the atomic flux can be completely shut off to the substrate while the source is still running, allowing for more precise exposure times. Source parameters may also be set up and stabilised prior to exposure without moving the substrate.

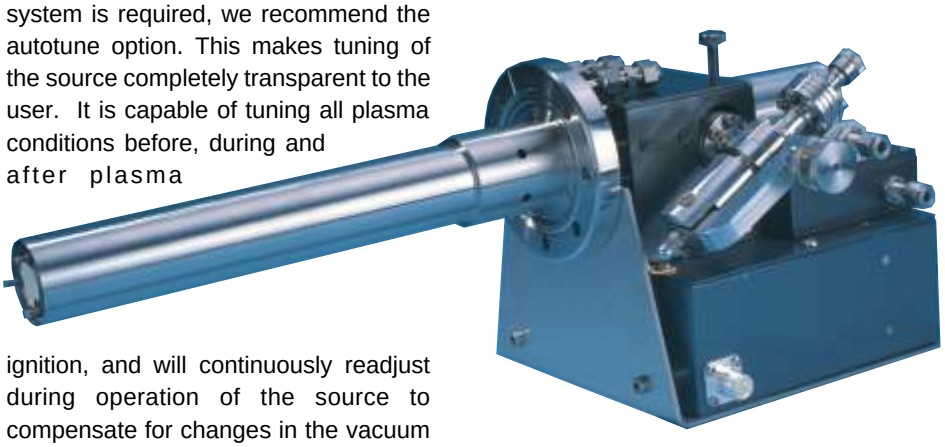
Optical monitor - OED100

A viewport with direct line of sight to the plasma is included as standard with all HD series sources. The optical monitor can be attached to this to measure the intensity of light emitted from the plasma and thus gain a measure of the efficiency of dissociation. The ability to measure the integrated intensity of optical emission has been enhanced by the addition of a spectral line filter which allows the intensity of a particular atomic line to be monitored. Switchable gain levels mean that both integrated and single atomic line intensities can be measured.

Automation Options

ATM Series autotune unit

Atom sources are fitted as standard with manual tune units which need adjustment when the plasma is ignited and subsequently if the operating conditions such as power and gas flow are changed. If the source is to be mounted in locations where access is restricted, or if full automation of the system is required, we recommend the autotune option. This makes tuning of the source completely transparent to the user. It is capable of tuning all plasma conditions before, during and after plasma ignition, and will continuously readjust during operation of the source to compensate for changes in the vacuum environment, such as temperature and pressure.



PCR Series plasma controller

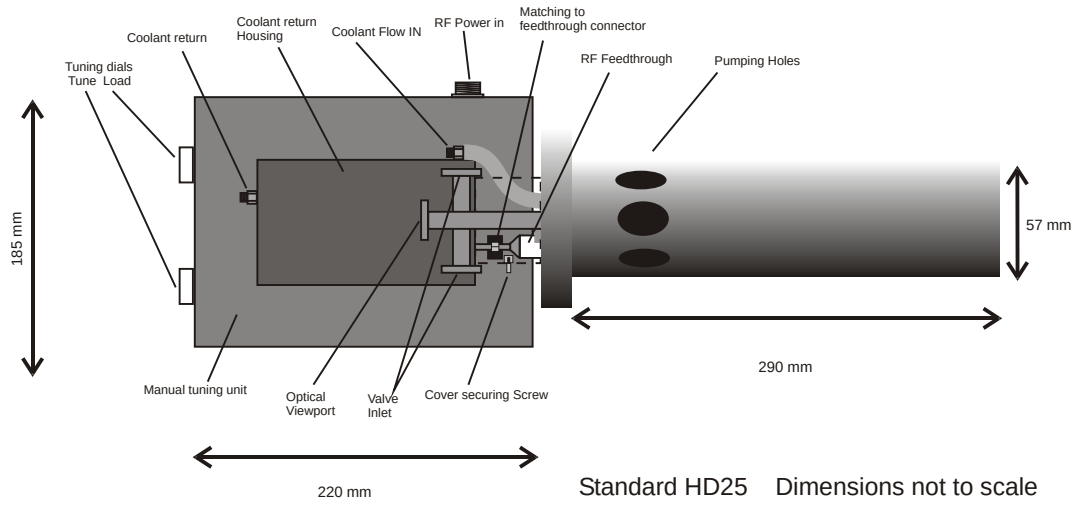
Changes in both gas flow and RF power applied to the Oxford Applied Research range of atom sources, produce an approximately linear response in the plasma brightness which has been shown to correspond to doping density and growth rate. It is therefore possible, by controlling plasma brightness, to control the atomic flux in the same way as temperature is used to control the flux from K-Cells. A control signal is generated from the optical monitor output (described above) and used to adjust the RF power to achieve complete stability of the plasma.

The controller provides long term stability of the source against thermal, pressure and other changes in the chamber and offers a useful safety feature that in the event of plasma failure, RF power to the source is automatically switched off.

Piezoelectric gas doser - PLV3000

The PLV3000 piezoelectric gas doser is available for remote control of the gas leak rate to the source. Please ask for our separate brochure on this product, or refer to our website.

Dimensions and Specifications



Standard HD25 Dimensions not to scale

Specials

In addition to our standard models, we also manufacture sources geared to a particular chamber application. We can recommend optimum working distances and supply apertures to give the best possible uniformity at a specified distance.

Model	HD20	HD25	HD60	HD150
In-vacuum diameter	34mm	57mm	96mm	196mm
Standard length	290mm	290mm	290mm	212mm
Beam diameter	20mm	25mm	50mm	150mm
Mounting flange	NW35CF (70mm/2.75”)	NW63CF (114mm/4.5”)	NW100CF (150mm/6”)	NW200CF (250mm/10”)
Max. operating power	400W	600W	600W	1,200W

Note: OAR also manufactures model HD25R specifically for users of some Riber MBE systems with non-standard port sizes. Please ask OAR for details

Flux: At a working distance of 100mm >$1x10^{16}$atoms/cm^2/sec

Standard equipment supplied: Source (to user-specified length & with viewport to plasma), RF cable, manual tuning unit, ion deflection plates and power supply

Services: 0.5l/min water cooling

Operating pressure: All sources can operate at chamber pressure <$5x10^{-3}$mbar

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