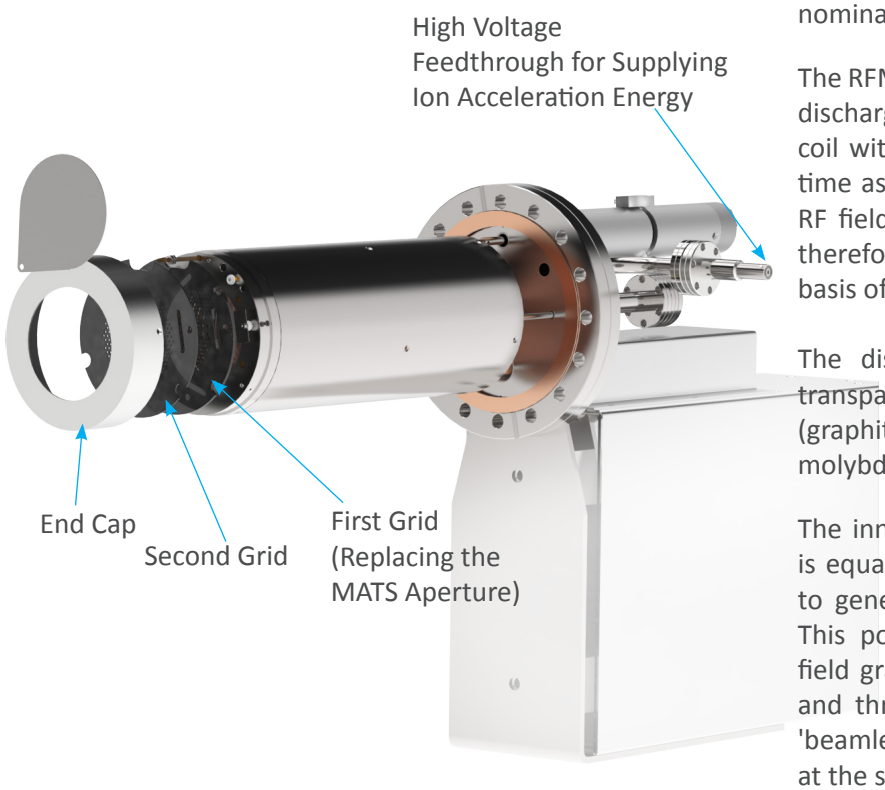
RFM
MATS Upgrade

Sample Cleaning

Thin Film Densification

Control of Film Chemical Composition

Gridded Ion Source



Beams of accelerated ions may be used to modify and surface clean substrates in a stable vacuum environment. By selecting the energy and composition of the ion beam the characteristics of a grown thin film can be optimised due to densification or modification of the substrates surface chemistry by removal of the native oxide.

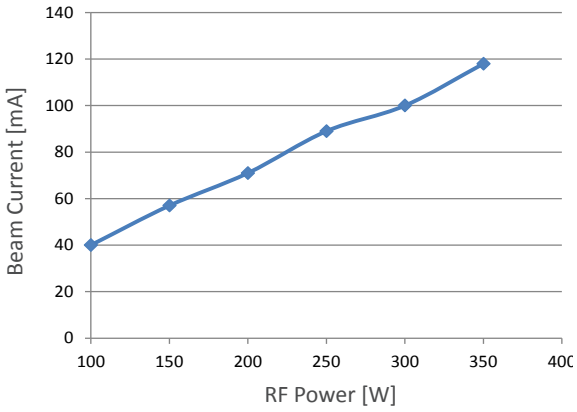
RFM MATS Upgrade Construction

The RFM is designed for use in UHV or HV deposition systems for applications such as sample cleaning, where a broad, energetic beam of ions is required with a moderately low energy spread. The RFM can generate ion beams from as low as 50eV up to 1000eV and with beam currents between 10mA and 150mA. The beams have a typical divergence of several degrees when using nominally flat grids.

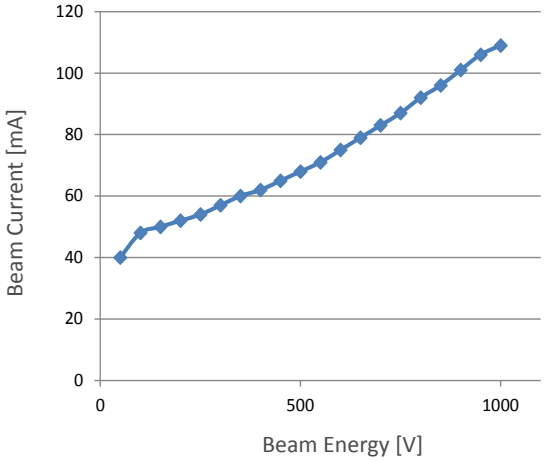
The RFM contains a helical coil wrapped around a ceramic discharge tube. RF power at 13.56MHz is applied to this coil with a power between 100 and 600W at the same time as a gas is introduced into the discharge tube. The RF field generates a plasma within the discharge tube, therefore supplying the charged particles which form the basis of the ion beam.

The discharge tube is enclosed by a pair of high-transparency grids. The grid material can be carbon (graphite), molybdenum or titanium. For most applications molybdenum or graphite grids are recommended.

The inner grid (beam grid) has a voltage applied which is equal to the energy of the ion beam the user wishes to generate. The outer grid is held at earth potential. This potential difference between the grids creates a field gradient which acts to draw ions from the plasma and through the holes in the outer grid. The multiple 'beamlets' combine to form one broad ion beam directed at the substrate.



Beam current vs. RF power at 500V beam energy and 9sccm oxygen flow.



Beam current vs. RF Beam Energy at 230W beam power and 9sccm oxygen flow.

Gas Compatibility

The RFM can be operated with oxygen, nitrogen or argon gas. The table below shows gas compatibility with various materials. It can also be used with some organic gases such as methane, but these should be heavily diluted with hydrogen gas to avoid carbon deposits forming on the inside of the discharge tube. Please contact MANTIS for recommendations on non-standard gases.

Grid Material	Gas Compatibility
Carbon	Ar, N_2
Molybdenum	Ar, O_2, N_2
Titanium	Ar, N_2

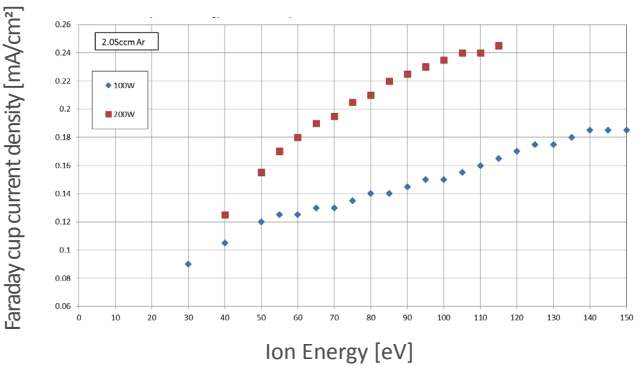
Tuning

Tuning provides a mechanism to couple RF power correctly to the plasma discharge. The RFM comes with automatic tuning units as standard. The automatic matching unit provides quick and precise tuning for matching the impedance of the source and the impedance of the RF power supply when plasma conditions change.

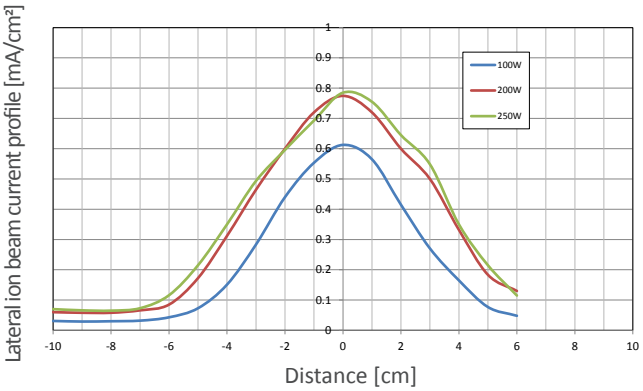
The RFM works harmoniously with MANTIS Titanium control software, and, can be integrated into fully automated deposition systems for sample cleaning. Available functions of the software package include automatic plasma ignition, automatic gas flow control and recipe process control. The automation package is suitable for both research and industrial applications.

Beam Neutraliser

A beam neutraliser can be added to the end of the RFM to inject electrons into the ion beam to ensure that the total charge arriving at the sample is near zero. This allows ion beam sputtering of dielectrics and better beam optics to be achieved.



Ion current density measured using a Faraday cup (0.02cm² area) for different RF Powers at a working distance of 73mm.



Argon ion beam current profile [mA/cm²] at 1keV and 5sccm gas flow, measured with a Faraday cup across the ion source, distance between RFM and Faraday cup is 150mm.

For further information please contact:
sales@mantis-sigma.com

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