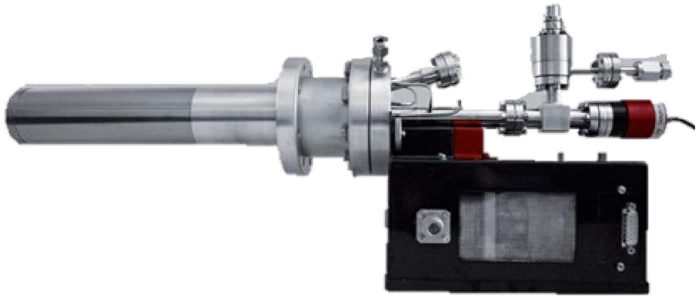
High speed RF Plasma Source for Nitrogen / Oxygen

RF-X 50/63

- **Up to several µm/h growth rates**
- **Largest range of models from research to production**
- **Optimized reactive species production**
- **Perfect for spintronics, high k applications, perovskites, MgZnO and related oxides**
- **Excellent for GaN based LED and power amplifiers**
- **Efficient gas consumption and reliable design**
- **More than 80 high speed sources installed worldwide**



Product introduction

Riber offers the largest range of RF sources on the market today and cover customer needs from research to production. Different materials for the discharge cavity are available to configure the source for reactive Nitrogen or Oxygen species. RF sources cover an array of applications such as Nitrides (GaInAlN…), diluted nitrides (GaInAsN, II-VI doping), Oxides (ZnO, spintronics, high-K…), diluted Oxides (Doping, mixed Nitride / Oxide),….

The minimum source configuration requires a cavity, a cell body, and a matching box (comprising a RF generator, cables and water switch).

Optical emission diagnostics (OED) can also be implemented onto the source for flux stability

Semiconductor grade gas panels are available for mass flow control, gas purification, and driving electronics. Dual gas injection panel is available in case gas mixing is requested.

Working principles

The RF plasma source operates by mean of an electrical field produced by the inductive coupling of the RF coil surrounding the cavity. A RF (13.56 MHz) generator delivers power to the discharge cavity space. To maximize power transfer to the plasma, a matching network is used to match the 50 Ohm impedance of the generator to the purely 50 Ohm impedance of the cavity load. Plasma in the cavity space produces atoms by dissociation of the molecular species. Atoms flow along with the non-dissociated molecules into the vacuum environment through an array of small holes at the front disk of the cavity («end–plate»).The hole arrangement is also called the «pattern». This pattern depends on application.

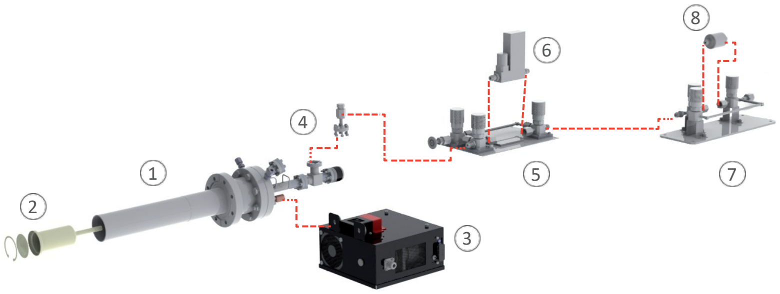
A large flux will require a large number of holes compared to an application where only a very small flux is required. Atoms generally have a very low recombination coefficient, so even those undergoing several wall collisions will ultimately contribute to the atom beam flux.

The electron sheet, covering the inside cavity walls, the hole sizes and shape are designed to minimize ions and electrons released from the cavity (Current lower than 10 nA / cm2).

Gas breakdown will occur above a certain pressure in the cavity. This pressure depends upon the gas ionization potential. As a result, and for a given cavity pattern, the flow rate of molecular gas will vary from gas to gas.

Plasma conditions is actively monitored via optical emission diagnostics to ensure flux stability and composition.

Layout

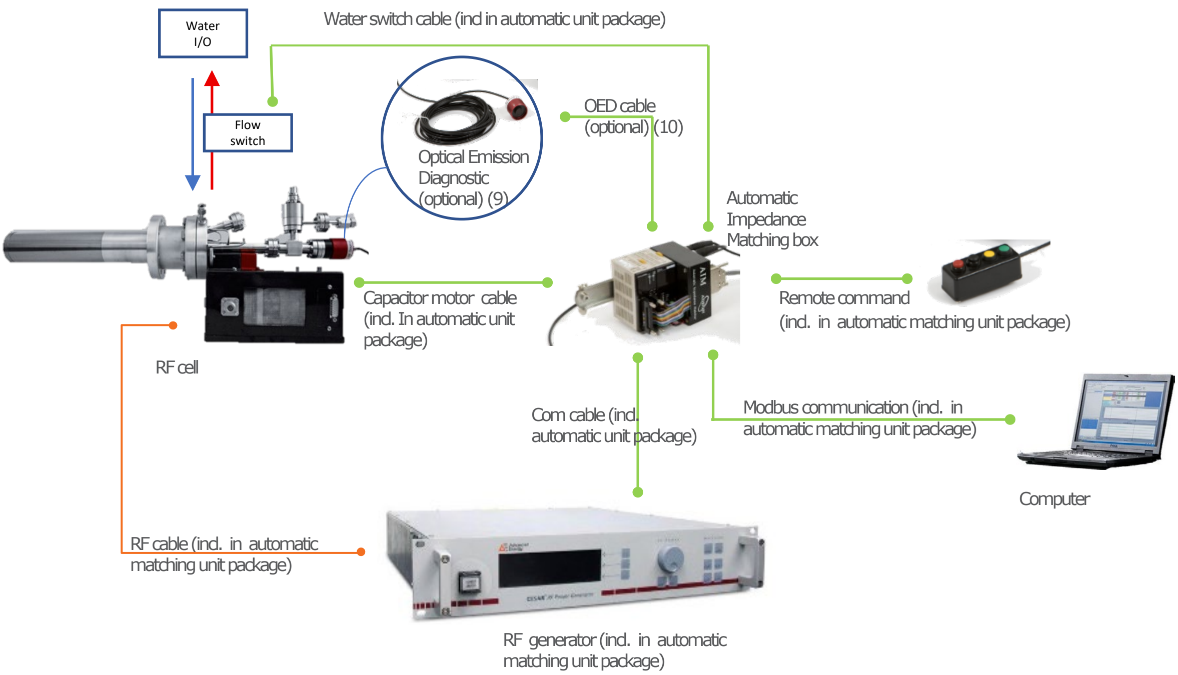


1 - Source body
2 – Cavity & end-piece
3 - Matching box
4 - Isolation valve
5 - Gas panel
6 - Mass flow controller
7 - Purifier panel
8 - Purifier cartridge

Specifications

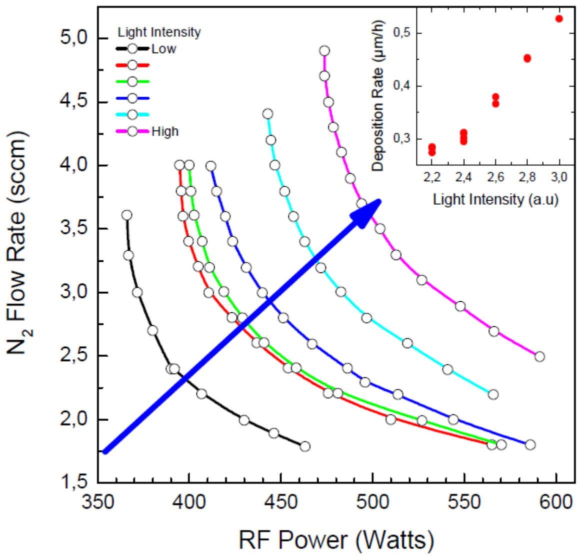
	RF-N 50/63	RF-O 50/63
Cavity Material	PBN	Quartz
Cavity type	Cavity with end-piece	
Mounting flange	CF 63 min – adaptations available	
Tuning unit	Automatic matching box (2 modules) - *manual version also available*	
Power supply	600 W	
Plasma observation viewport	CF 16	
Isolation valve	Included	
Gas inlet	DN CF 16 / VCR ¼''	
RF coil water cooling	Included – Ø6mm Swagelok connection DP>2 bars 0,3 l/min	
RF tuning unit cooling	Air	
Water security switch	Included	
Options	Plasma optical emission detection	
	Deflection plates	
	Gas panel + mass flow controller	
	Gas purifier panel	

Component interfacing



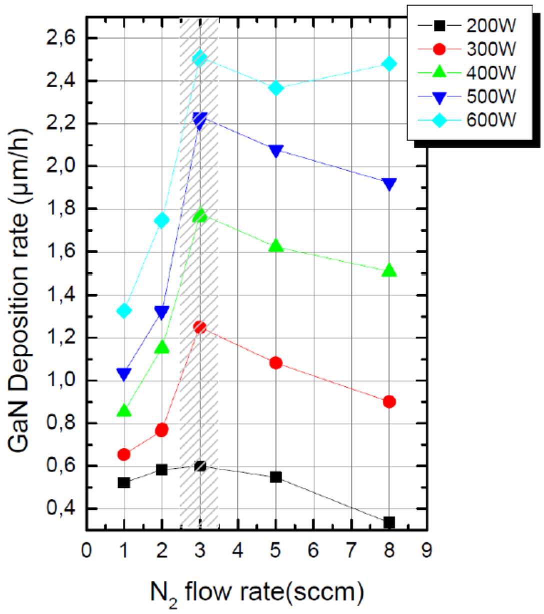
Working conditions of the RF 50/63*

Both the RF power and the flow rate of nitrogen influence the GaN deposition rate. The OED light intensity is directly correlated with the GaN deposition rate.



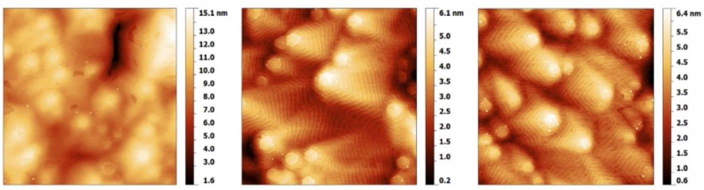
Very high growth rates*

Amazing GaN growth rate achieved, up to 2.5 µm/h with superb crystalline quality using Riber RFN-50/63, 1200 holes end-piece



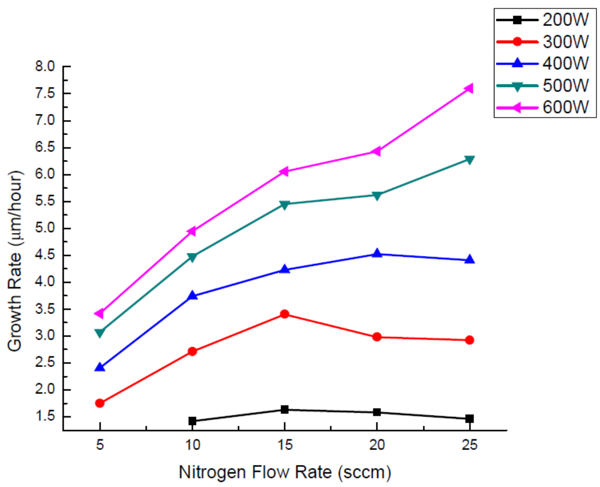
Surface morphology*

All samples were grown with plasma conditions of 500 W and with N2 flow rate of 15 sccm corresponding to a growth rate of ~5.5 µm/h, 5880 holes end-piece. The average RMS is of the order of 1 nm.



3 µm x 3 µm AFM images of the UID.

Growth rate map demonstrating the growth rate's dependence on plasma source power and N2 flow rate. Maximum growth rate achieved was ~7.6 µm/h for plasma conditions of 600 W, 25 sccm, 5880 holes end-piece



*** Results obtained on a Compact 21 single 3'' wafer system**

CELLS & COMPONENTS – PLASMA Nitrogen / Oxygen

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