

# AURA-WAVE

Ref. CPSKFDN40ECR2DP

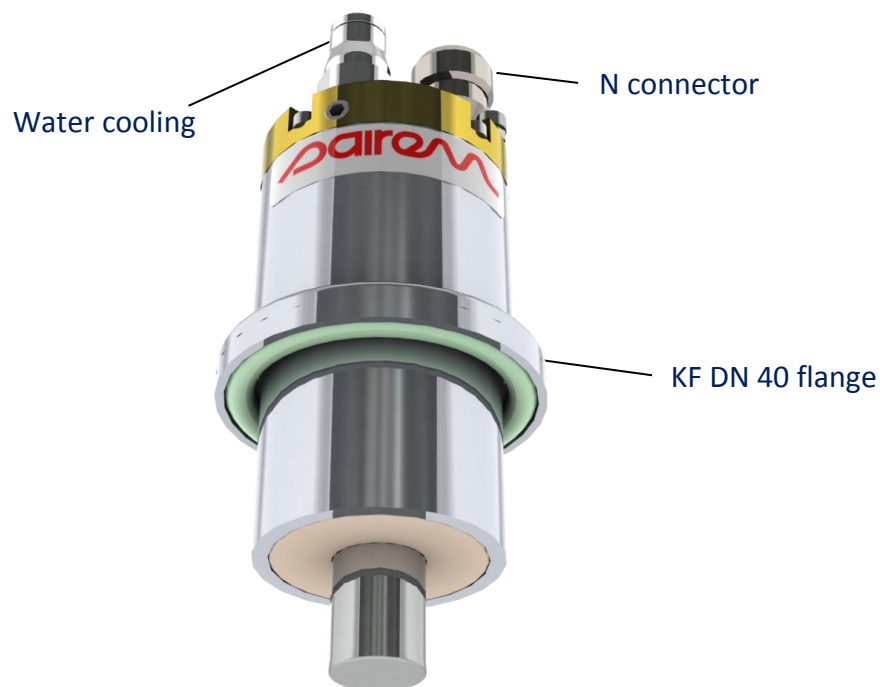


**AURA-WAVE** is an **Electron Cyclotron Resonance (ECR)** coaxial plasma source [1]. It has been designed to be self-adapted once the plasma ignited. A magnetic field combined to the electromagnetic wave allows the creation of plasma at low pressure due to **Electron Cyclotron Resonance**.

The **AURA-WAVE** ECR microwave plasma source has been designed to sustain microwave plasma over several decades of pressure, i.e. from  $10^{-4}$  mbar to a few  $10^{-2}$  mbar and from a few watt microwave power whatever the gas. Equally, the coaxial plasma source was designed to avoid inside power-losses and has proved to be matched [2-5], i.e. no reflected power with no additional impedance matching system over 2 to 3 pressure decades, depending on the plasma gas. Plasma density up to a few  $10^{11} \text{ cm}^{-3}$  [6] could be easily obtained in multisource configuration in different gases like argon, oxygen, nitrogen.

When combined with SAIREM solid state microwave generator, it possible to control the power transmitted to the plasma with one watt increment; low mismatching that may appear in the operating conditions can be balanced due to the variable frequency of the solid state generator and thus permits to extend the operating condition range of the **AURA-WAVE**.

**AURA-WAVE** is designed to be used equally in R&D laboratories and industry for a very large range of applications. Typical applications of such source are generation of radicals (e.g. atomic oxygen), etching, PECVD, surface treatment (nitration, cleaning etc.) and it is ideal for working in the low pressure range i.e. with high energy particles.



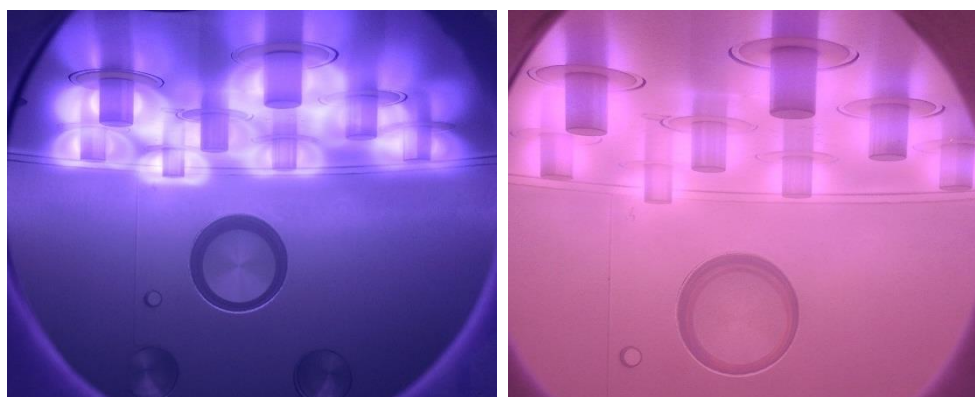
**AURA-WAVE** ECR coaxial plasma source

## Technical specification

REF	CPSKFDN40ECR2DP
Frequency	2400 – 2500 MHz, 0.1 MHz increment
Microwave power	Max. 200 W
Working pressure range	A few $10^{-4}$ mbar to a few $10^{-2}$ mbar
Plasma density (measured in Ar-O <sub>2</sub> -N <sub>2</sub> )	<u>One source</u> : $2-5 \times 10^{10}$ cm <sup>-3</sup> at 160 mm $\sim 10^{11}$ cm <sup>-3</sup> at 100 mm <u>Multisource</u> : $10^{11}$ cm <sup>-3</sup> at 160 mm a few $10^{11}$ cm <sup>-3</sup> at 100 mm
Connections	Standard KF DN40 flange
Cooling by water	Push-fit connectors for OD 6 mm tubing. Water-cooling of the sources is mandatory (at least 0.5 l/min). <b>The warranty will be void in case of operation without water-cooling.</b>

## OBSERVATIONS

Multi-sources can be used for scaling-up in crown distribution for volume plasma processing or in matrix distribution for planar plasma processing. As each *AURA-WAVE* has its own microwave generator, it is possible to control exactly the transmitted power to each plasma source whatever the number. For example, in matrix distribution, the losses in uniformity due to edge effect of the peripheral plasma sources can be compensated by increasing their microwave power and thus increase the surface of uniform treatment area.



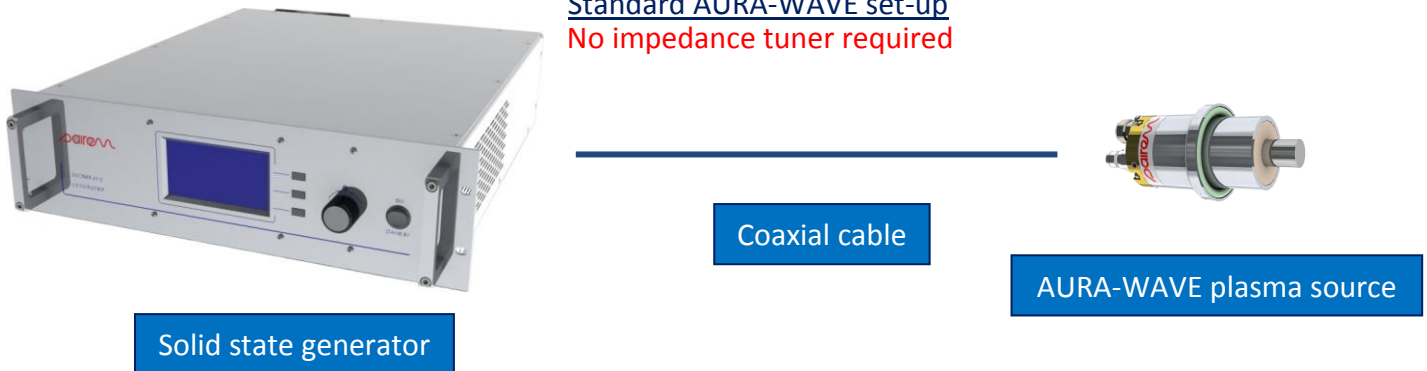
Example of integration of 8 **AURA-WAVE** sources on the top lid of a plasma reactor  
– Argon plasma at  $10^{-2}$  mbar, 20 W / source – N<sub>2</sub>-Ar plasma at  $10^{-2}$  mbar, 100 W / source.  
In this example it is possible to integrate up to 16 **AURA-WAVE** for 300 mm processing.

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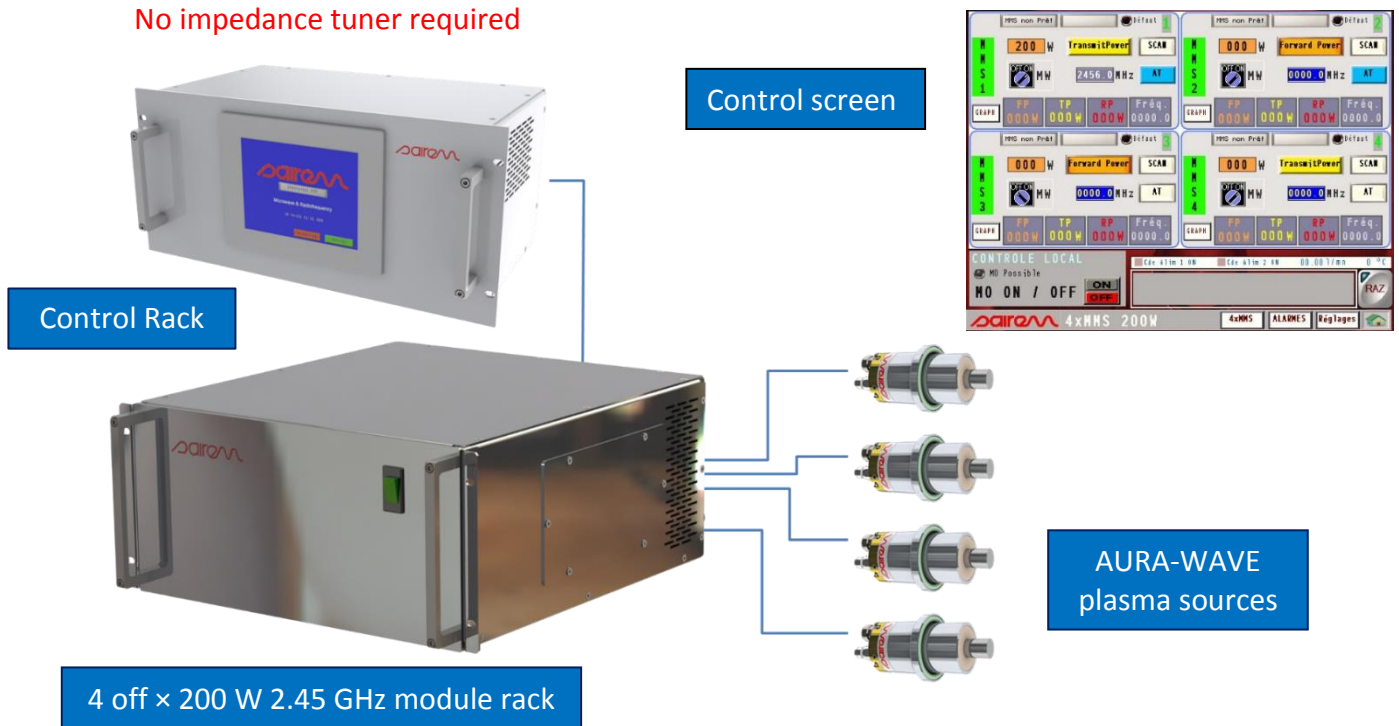
## SET-UP of AURA-WAVE and solid state microwave generator

The functionality of the plasma source is possible if the source is connected to a 2.45 GHz solid state microwave generator. In case of multiple plasma sources, solid state modules can be integrated; the control can be done via CANopen® or via a control rack with a touch screen.



## Multiple AURA-WAVE set-up. The control rack permits to control each AURA-WAVE with 1 W step

No impedance tuner required



## REFERENCES

- [1] S Béchu, A Bès, A Lacoste, J Pelletier, Device and method for producing and/or confining a plasma, Patent WO 2010/049456.
- [2] L Latrasse, M Radoiu, J-M Jacomino, B Depagneux, Design of an ECR coaxial microwave plasma source "AURA-WAVE" using solid state microwave generator, 14th International Conference on Microwave and High Frequency Heating, Nottingham, UK (2013).
- [3] L Latrasse, M Radoiu, J-M Jacomino, A Grandemenge, Facility for microwave treatment of a load, Patent WO 2012/146870.
- [4] L Latrasse, M Radoiu, Elementary device for applying a microwave energy with coaxial applicator, Patent WO 2017/060611.
- [5] L Latrasse, M Radoiu, T Nelis, O Antonin, Self-matching plasma sources using 2.45 GHz solid-state generators: microwave design and operating performance, J Microw Power Electromagn Energy. 2017, DOI: 10.1080/08327823.2017.1388338.
- [6] L Latrasse, M Radoiu, J Lo, P Guillot, 2.45-GHz microwave plasma sources using solid state microwave generators. ECR-type plasma source. J Microw Power Electromagn Energy. 2017, 50:308-321.



