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Gencoa FFE430

300mm static wafer coating

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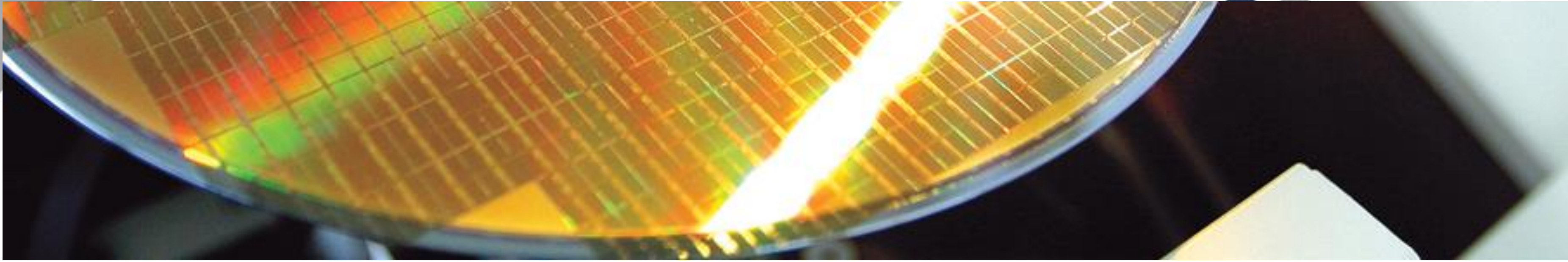
High performance components from Gencoa for Semiconductor Applications



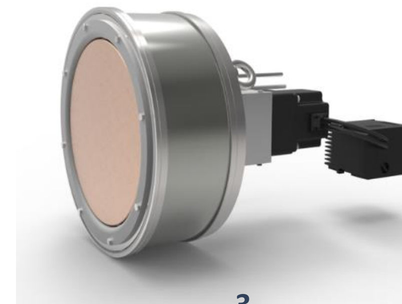
- New and retro-fit magnetrons and magnetics
- Reactive gas control & End Point Detection

Gencoa FFE Circular Magnetron

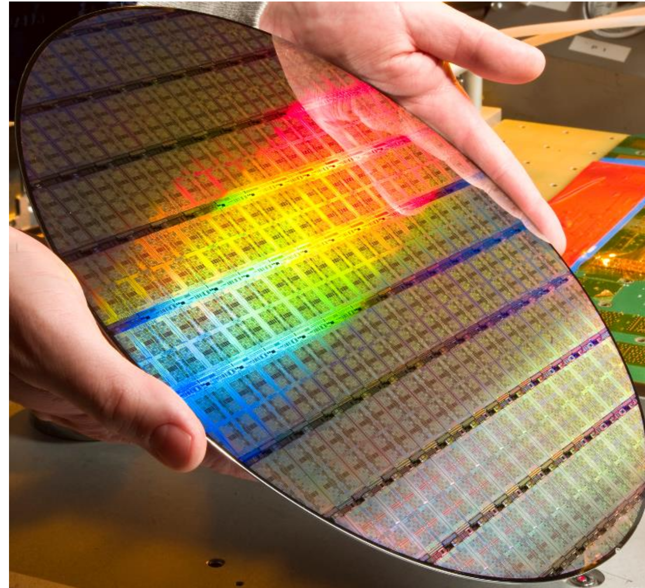
- Dynamic plasma movement for full face erosion
  - Clean target for defect free layers
  - High target use for precious metals
  - Better Uniformity
- 2 version available, depending on design and magnetic modelling
  - Standard FFE
    - 250mm (10”)- 430mm (17”) target
    - Flexible uniformity control
    - Same magnetic pack suitable for different materials
    - HIPIMS, RF and DC compatible.
  - Small FFE
    - 75mm (3”)- 200mm (8”) target
    - Unique in the market
    - Externally or internally mounted with all mechanical options (e.g. tilt, shutter , gas injection etc) offered
    - Suitable for R&D and Optics industry

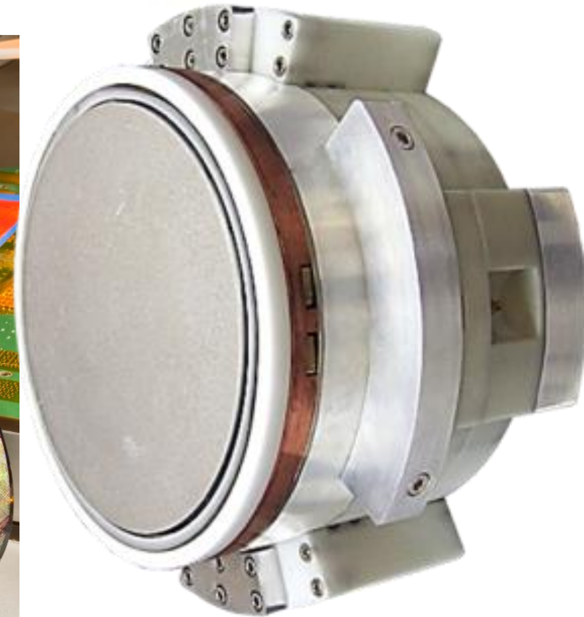
ffe100

ffe300

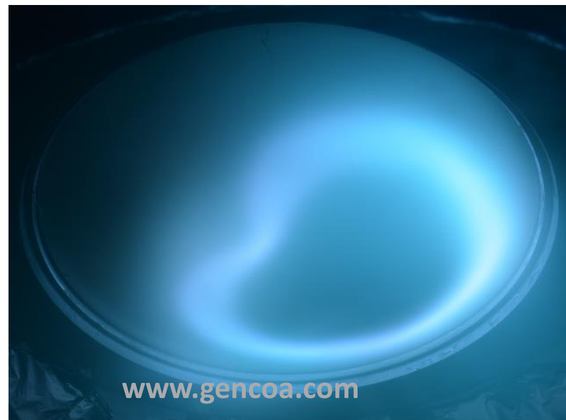


300mm static wafer coating





430 FFE



450 FFE

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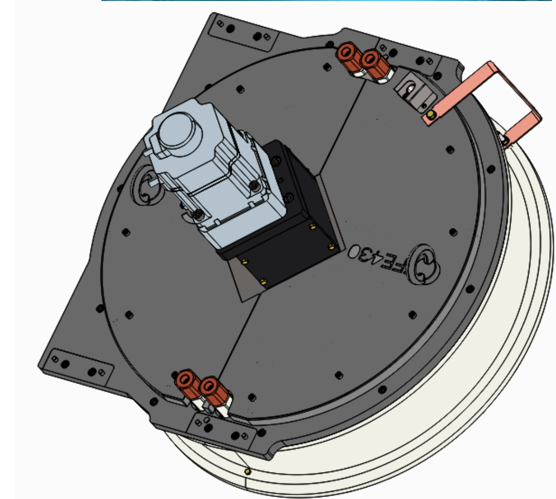
Gencoa FFE 430 Key Features

- No magnet pack in water – easily accessible
- Slow to Fast rotation of the magnets provides:
    - Uniformity tuning ability via speed control
    - Better arcs suppression – less time for charge-build-up at higher rotation speeds
    - Less layer defects from arc events
- Better than ±3% uniformity achievable for wafers upto 300mm(12”) diameter
- Same magnetic pack suitable for different materials (ferro-magnetic targets require different magnetics)
- High power capacity – high water flow with 2 water in and 2 water out and directly cooled targets
- Control of coating uniformity throughout target life via RPM/Pressure within +/-4%.
- All vacuum and water seals are static – no rotation, hence no wear and leaking with time which maximizes up-time and minimizes maintenance costs



Gencoa FFE 430 Design Features

Water Out

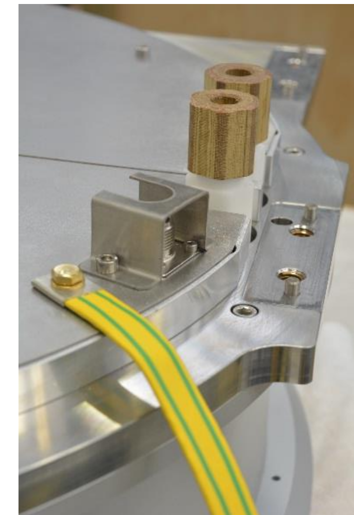
Earth Strip

Motor Assembly

Power Connector

Water In

Flip mechanism



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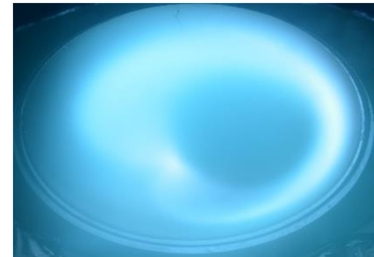
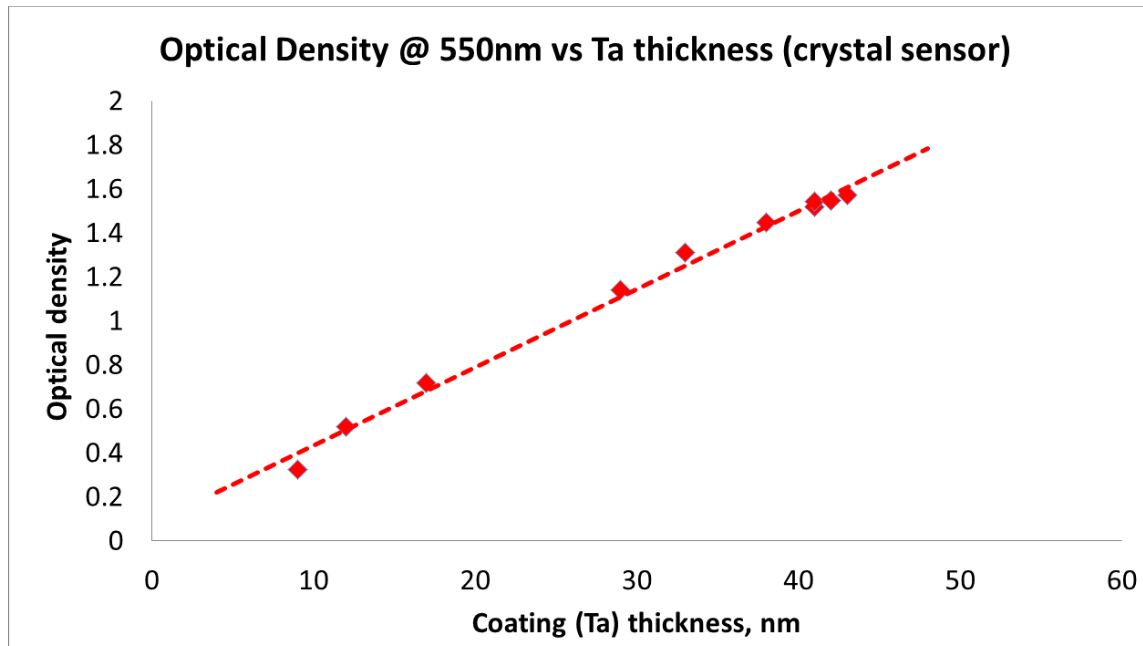
Gencoa FFE 430-
Flexible uniformity control

- Different methods to adjust uniformity
  - Varying rotational speed of the array (50-120 rpm)
  - Adjusting position of the magnetic pack relative to the central axis of rotation – mechanical change
  - Use shunts to tune magnetics – mechanical change



Optical Density Measurements

Light transmittance decreases exponentially as it travels through the material then the Optical density (OD) is proportional to coating thickness.

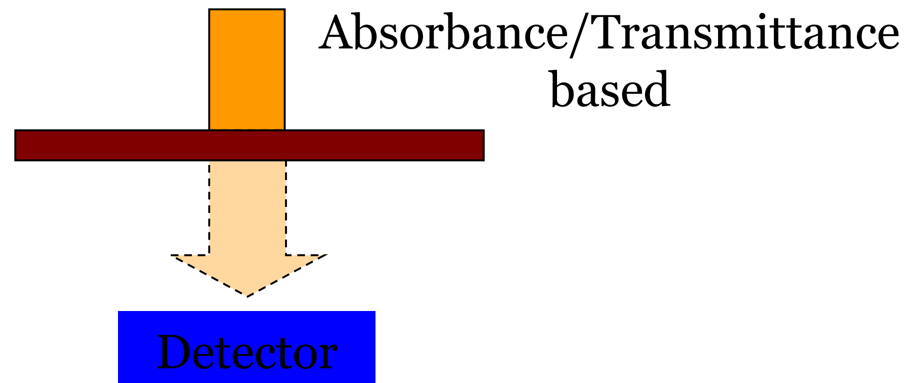


Example of FFE300 deposited Ta coating Optical density (@ 550nm) versus the ta thickness as measured by crystal sensors.

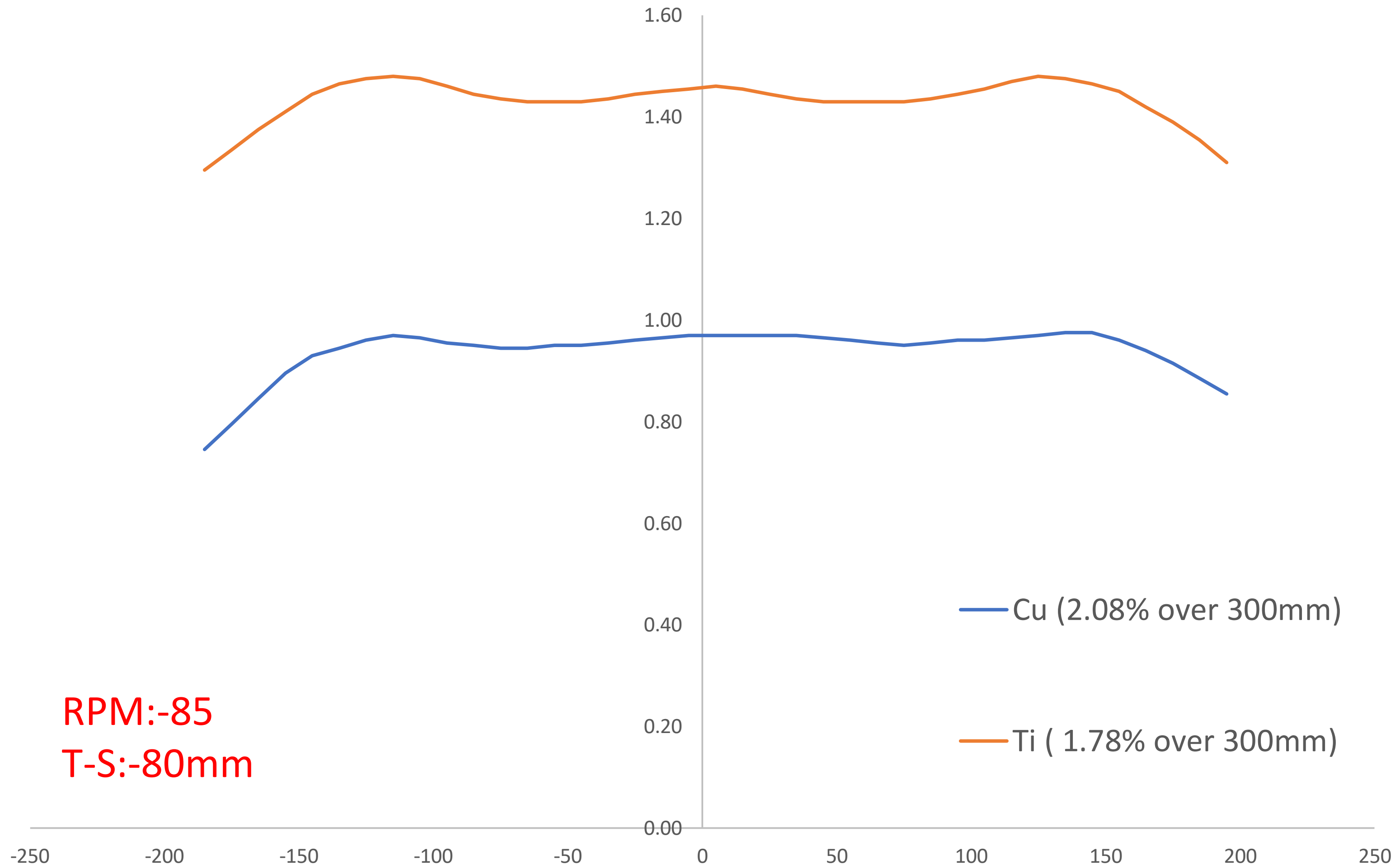
Optical Density Measurements

Optical density = Absorbance

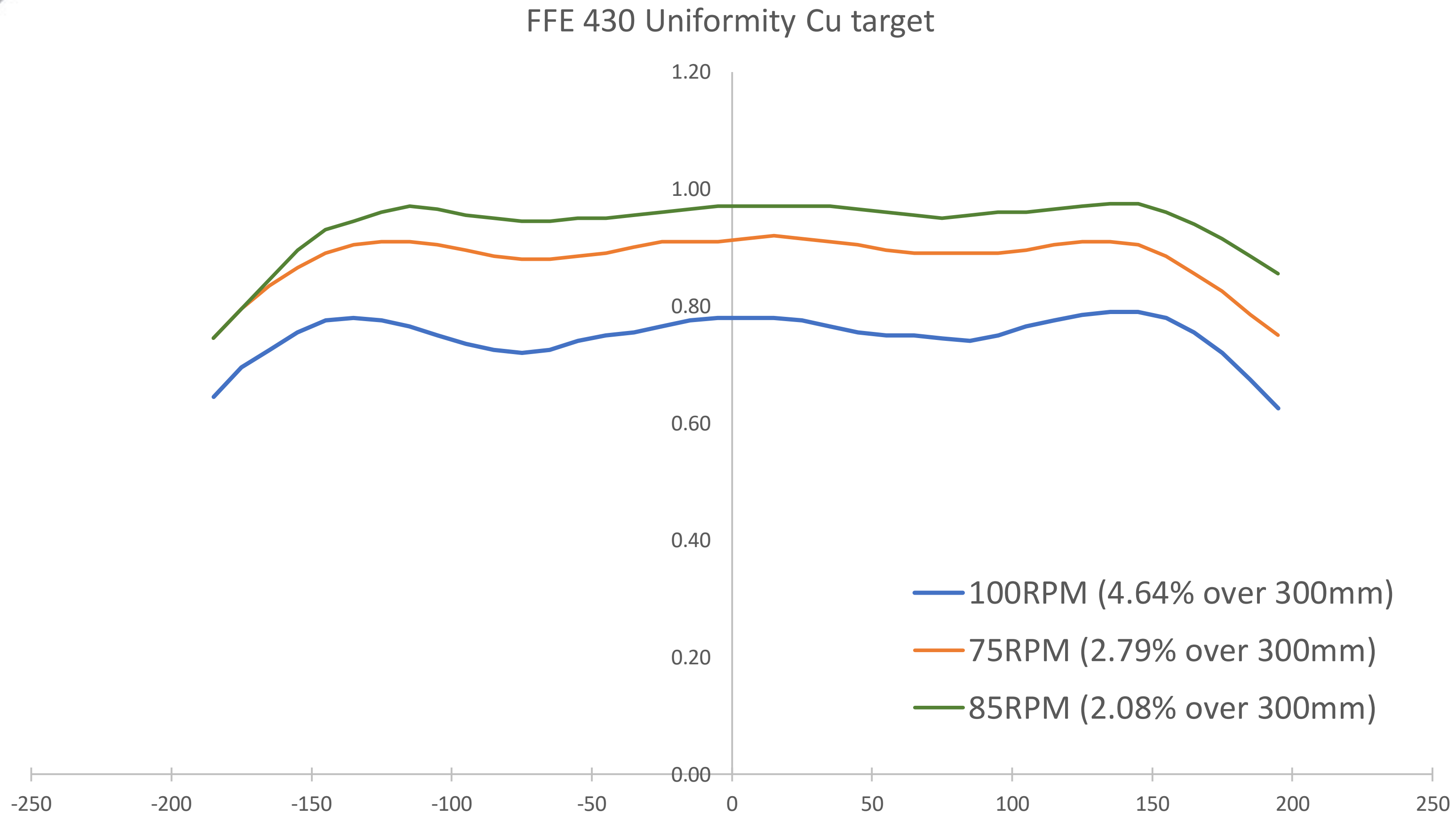
$$A_l = \log_{10} (I_o/I) = -\log_{10}(T)$$



One magnetic pack for different material



Cu target uniformity at various RPM @80mm T-S



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FFE430 at 75 mm T/S distance

Coating uniformity during erosion test

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FFE430-Cu Target Erosion Test Conditions

- Target material: Cu (C101)
- Power: 5 kW DC
- Gas: Ar
- Pressure: 5.9 E-3 mbar
- System: barrel @ Gencoa
- Special shielding in order to protect turbopump contamination

FFE430-Cu Target Testing Data Gencoa Sputter Calculator

https://www.gencoa.com/customers/apps/sputtercalc/index.php

thin film components | better magnetic design | integrated solutions | OEM support | process specific

gencoa-online Universal sputter process calculator

Note: For Internet Explorer users the enter key does not update the data, please click any mouse button instead.

Magnetics

Rectangular | Circular | Rotatable

Target Diameter (mm) 430
Target Thickness (mm) 12.7 Target Area (cm2) 1452.20

Materials

Material 1 | Material 2 | Material 3 | Material 4 | Misc

Material Type: All Pure Compound Reactive

Material Name: Copper

Relative Sputter Rate 1.000

Power Value: Power Density / Total Power
Power Type: DC / RF

Total Power (kW) 1 Power Density (W/cm2) 0.6886103842

Substrates

Substrate 1 | Substrate 2 | Substrate 3 | Substrate 4

Target to Substrate Distance (cm) 7.5
Substrate Speed (cm/min)
Number of Passes 1

Substrate Direction: Across Target Width / Across Target Length

Coating Thickness and Target Material

Coating Thickness for Layer (nm) 0
Target Material Left Unsputtered (mm) 0

Coating Rate

	Worst Case (1 - Factor)	Average Case (1.25 - Factor)	Best Case (1.5 - Factor)
Approx. Static Coating Rate (nm/min)	58.8	73.5	88.1
Coating Thickness (nm)	2239.2	2799.0	3358.8
Dynamic Coating Rate (nm.m/min)	2239.2	2799.0	3358.8
No of Magnetrons (1 side only)	1	1	1

Standard Magnetics

Target Use (%) 25
Target Lifetime (continuous hours) 600.4
Target Lifetime (kilowatt hours) 600.4

High Yield Magnetics

Target Use (%) 45
Target Lifetime (continuous hours) 1080.6
Target Lifetime (kilowatt hours) 1080.6

FFE Magnetics

Target Use (%) 60
Target Lifetime (continuous hours) 1440.9
Target Lifetime (kilowatt hours) 1440.9

Rotatable Magnetics

Target Use (%)	60	80
Target Lifetime (continuous hours)	0.0	0.0
Target Lifetime (kilowatt hours)	0.0	0.0

Calculation for 12.7 mm target erosion

Estimated Target Use %	Expected kW.h
25%	600
45%	1081
60%	1441

FFE430-Cu Target Testing Data
Gencoa Sputter Calculator

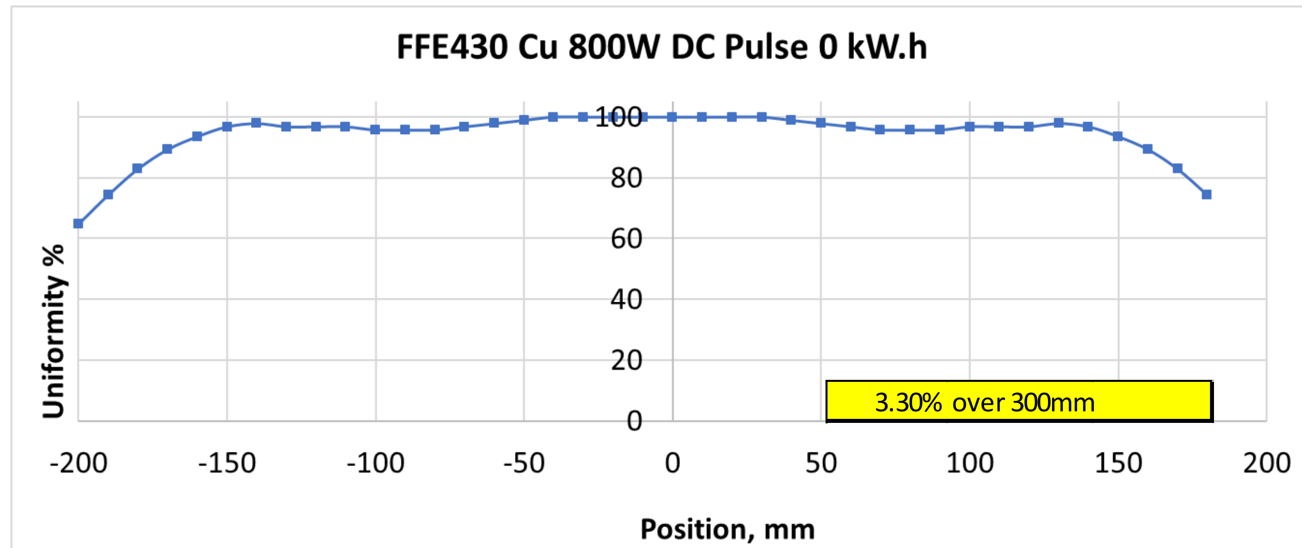
https://www.gencoa.com/customers/apps/sputtercalc/index.php

Assuming 45% target use, the experiment would be expected to finish around 1100 kW.h for 12.7 mm target thickness (+12.7 mm backing plate)

Estimated Target Use %	Expected kW.h
25%	600
45%	1081
60%	1441

FFE430-Cu Target at 0kW.h

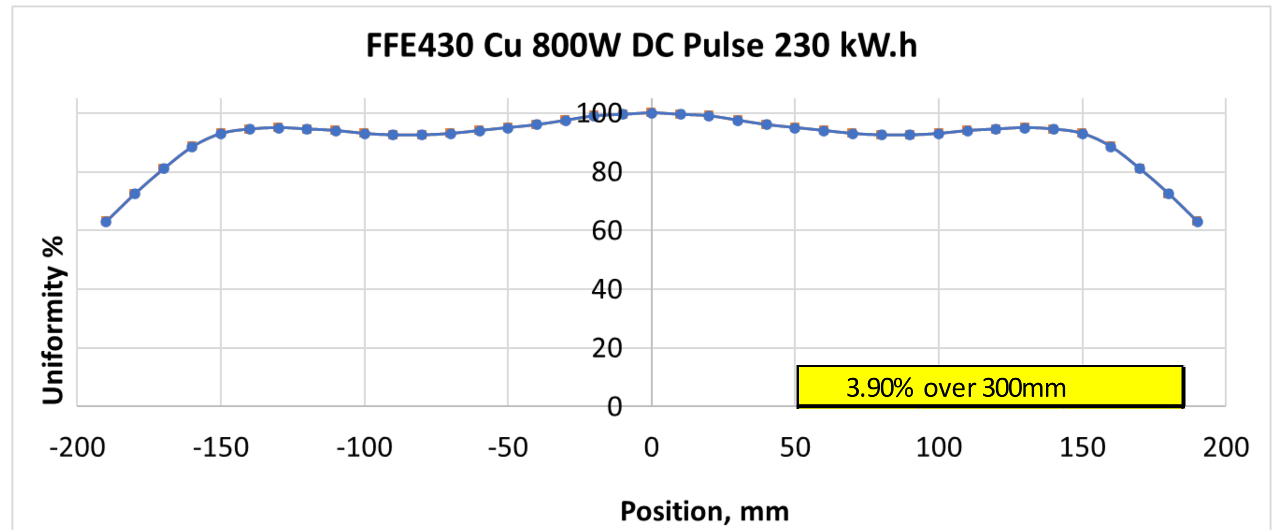
Pressure	5.9 E-03
RPM	105
Gas (Ar)	**10%**
Shunting	None
Power	800W DC Pulse
Time	44s
Array Position	**1**
T/S	75mm
voltage	314
current	2.54
Pumping	18hours
Pulse Frequency	100kHz
Pulse Width	2016 ns



Uniformity normalised to 100%

FFE430-Cu Target at 230 kW.h

Pressure	5.9 E-03
RPM	**30**
Gas (Ar)	**10%**
Shunting	None
Power	800W DC Pulse
Time	90
Array Position	**1**
T/S	75mm
voltage	308
current	2.61
Pumping	6 hours
Pulse Frequency	100kHz
Pulse Width	2016 ns

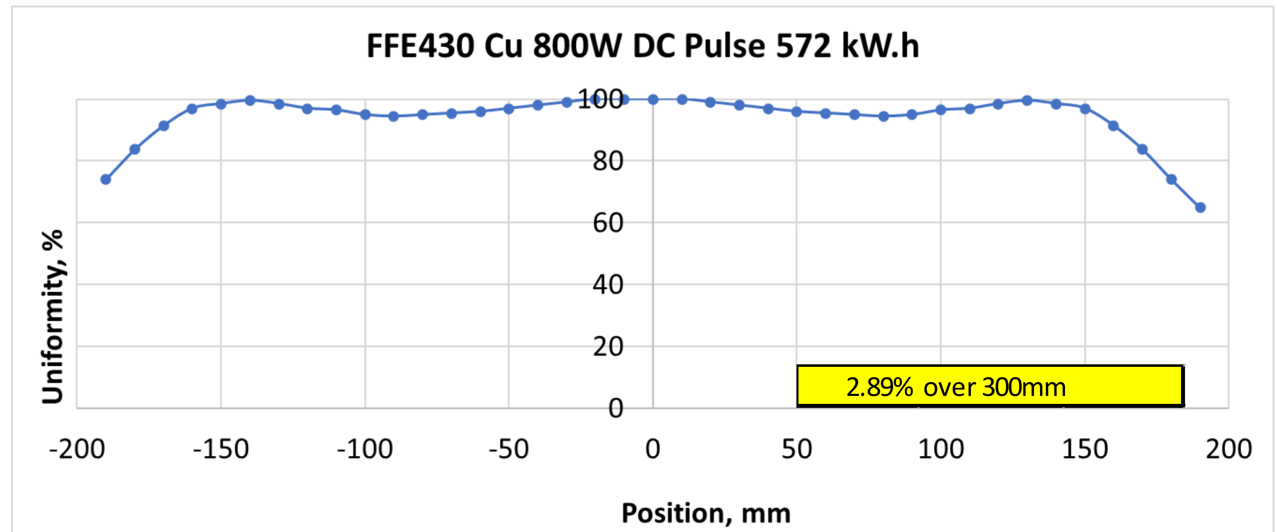


Uniformity normalised to 100%

FFE430-Cu Target at 230 kW.h

FFE430-Cu Target at 572 kW.h

Pressure	5.9 E-03
RPM	**60**
Gas (Ar)	**10%**
Shunting	None
Power	800W DC Pulse
Time	90
Array Position	**1**
T/S	75mm
voltage	308
current	2.61
Pumping	overnight
Pulse Frequency	100kHz
Pulse Width	2016 ns



Uniformity normalised to 100%

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FFE430-Cu Target at 572 kW.h

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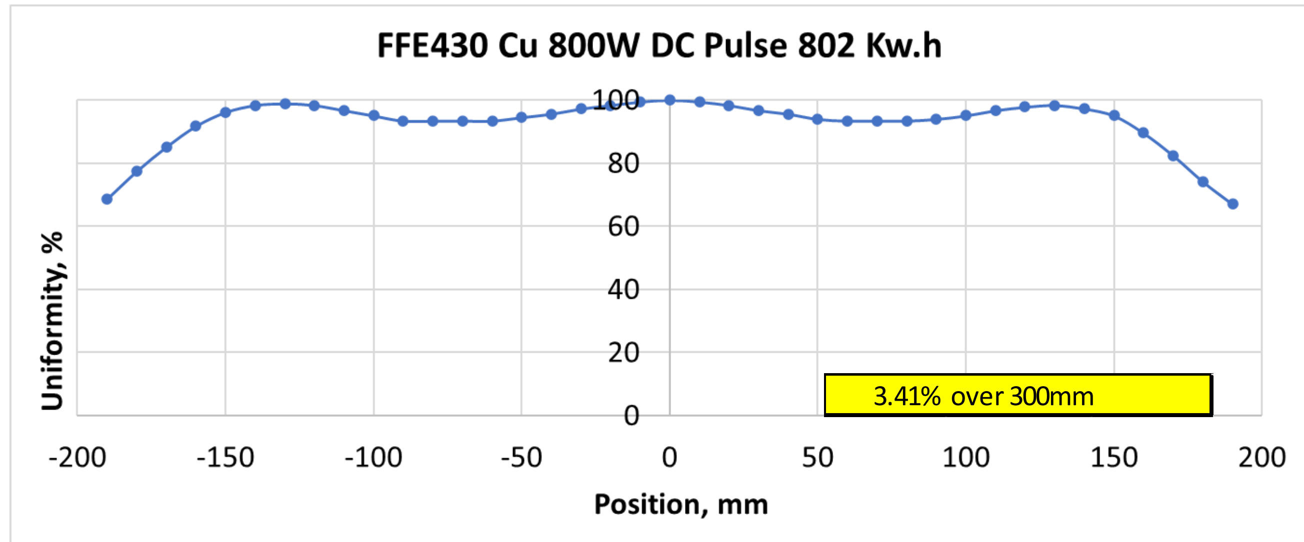
FFE430-Cu Target at 802 kW.h

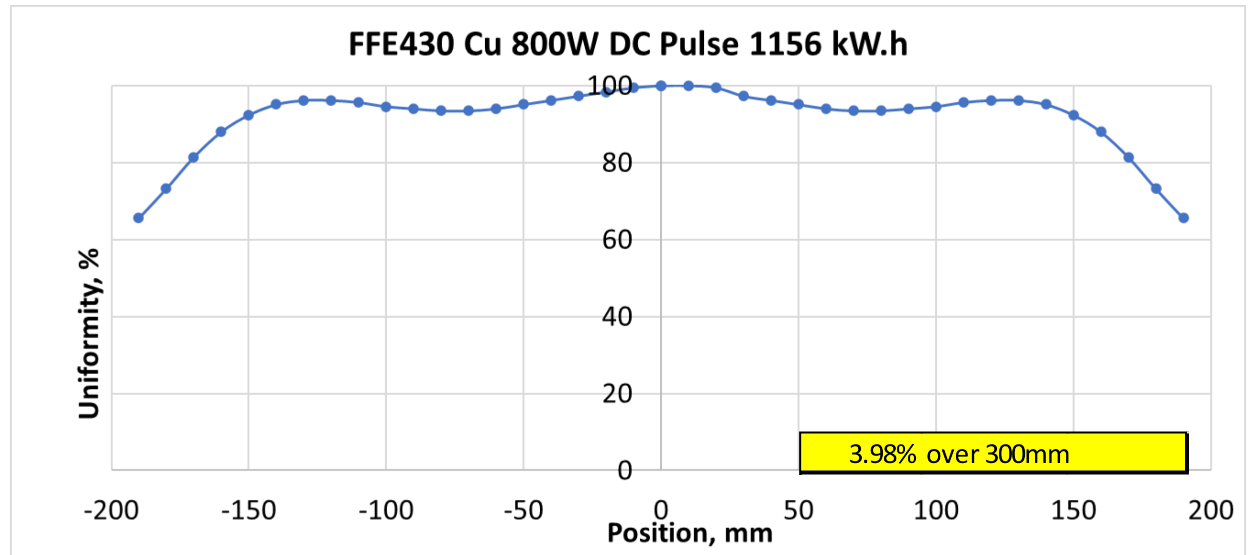
Pressure (mbar)	5.9 E-03
RPM	**90**
Gas (Ar)	**10%**
Shunting	None
Power	800W DC Pulse
Time	14:30
Array Position	**1**
T/S	75mm
voltage	308
current	2.61
Pumping	over weekend
Pulse Frequency	100kHz
Pulse Width	2016 ns



Uniformity normalised to 100%

FFE430-Cu Target at 1156 kW.h

Pressure (mbar)	5.9 E-03
RPM	**120**
Gas (Ar)	**10%**
Shunting	None
Power	800W DC Pulse
Time	09:30
Array Position	**1**
T/S	75mm
voltage	309
current	2.59
Pumping	over night
Pulse Frequency	100kHz
Pulse Width	2016 ns



Uniformity normalised to 100%

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FFE430-Cu Target at 1156 kW.h

FFE430 – Cu target

Deposition Rate

Pressure (mbar)	5.9 E-03
RPM	**90**
Gas (Ar)	**10%**
Shunting	None
Power	2000W DC Pulse
Time	14:30
Array Position	**1**
T/S	75mm
voltage	308
current	2.61
Pumping	over weekend
Pulse Frequency	100kHz
Pulse Width	2016 ns

Crystal sensors
Quartz-gold

Average deposition rate= 73 nm/(min.kW)

FFE430-Cu Target Testing Data
Gencoa Sputter Calculator

https://www.gencoa.com/customers/apps/sputtercalc/index.php

Calculation at 1 kW

Coating Rate

	Worst Case (1 - Factor)	Average Case (1.25 - Factor)	Best Case (1.5 - Factor)
Approx. Static Coating Rate (nm/min)	58.8	73.5	88.1

Experimental average deposition rate= 73 nm/(min.kW)

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FFE430-Cu Target Erosion

Original target & backing plate weight: 38.7 kg
Eroded target & b/p at (1156 kW.h): 29.2 kg

Total eroded weight: 11.5 kg

Maximum target erosion depth: 17.6 mm

Original intended erosion was 12.7 mm , therefore target use will be < 45%

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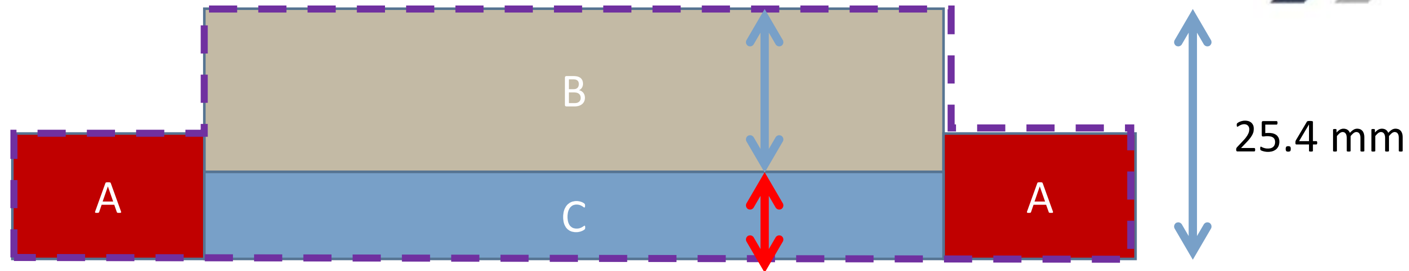
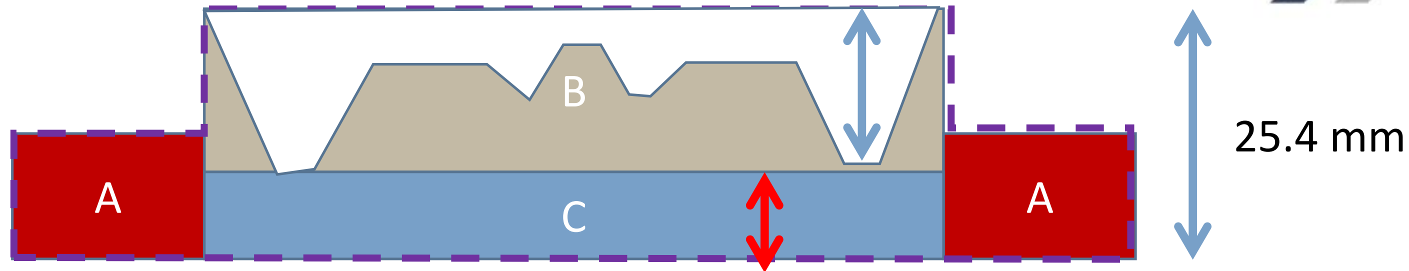
FFE430-Cu Target erosion

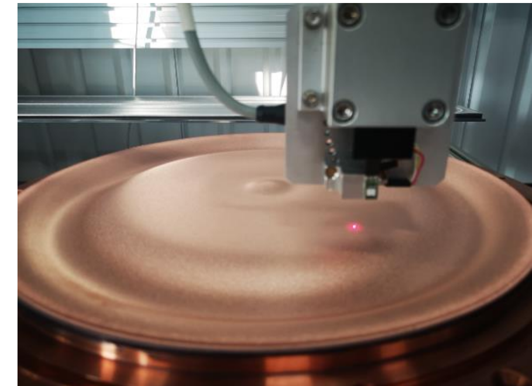


Target (B) thickness mm	A weight, kg	B weight, kg	C weight, kg	Total weight, kg
12.7	5.7	16.5	16.5	38.7
17.6	5.7	22.9	10.1	38.7

FFE430-Cu Target erosion



Target (B) thickness mm	Original B weight, kg	Eroded B weight, kg	Target use %
17.6	22.9	9.5	41.5%



A laser scanning profile system was used in order to evaluate the target erosion

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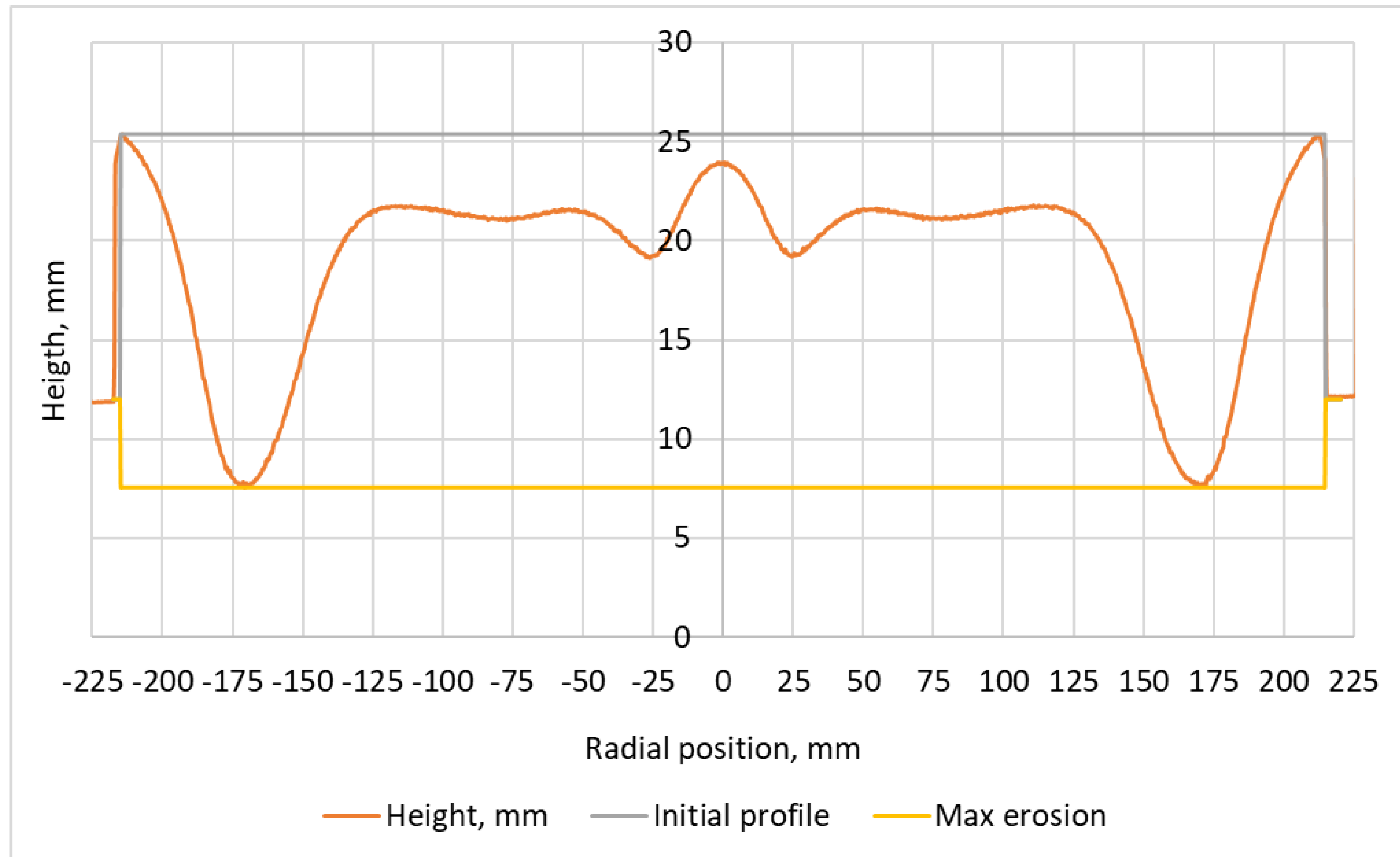
FFE430-Cu Target Erosion Profile

Target erosion based on profile: 41.6%



Profile has been calculated after discounting the deformation of the backing plate

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FFE430-Cu Target Erosion Test

- Full face erosion profile achieved.
- Coating uniformity less than ± 4% achieved through out target life by adjusting only the RPM (75 mm T-S distance)
- Effective target use of 41.5% (at 1156 kW.h) for 17.6 mm depth.
- Average deposition rate = 73 nm/(min.kW)