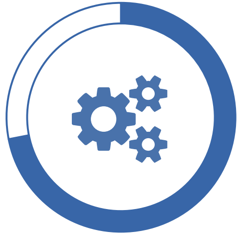
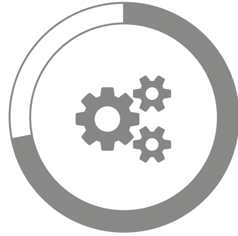
CORIAL
A Plasma-Therm Company

CORIAL 210D

High quality films deposition at low temperature



SiO_2, Si_3N_4, SiOF, SiOCH, aSi-H, SiC deposition at low temperature (20°C to 150°C)



Reactor flexibility to accommodate a wide range of customer applications in RIE, ICP-RIE, and ICP-CVD modes

Adaptable to a wide range of substrate sizes: wafer pieces, 1x2'' to 7x2'' ; 1x3'' to 3x3'' ; 1x4'' ; 1x6''

SYSTEM DESCRIPTION
CORIAL 210D

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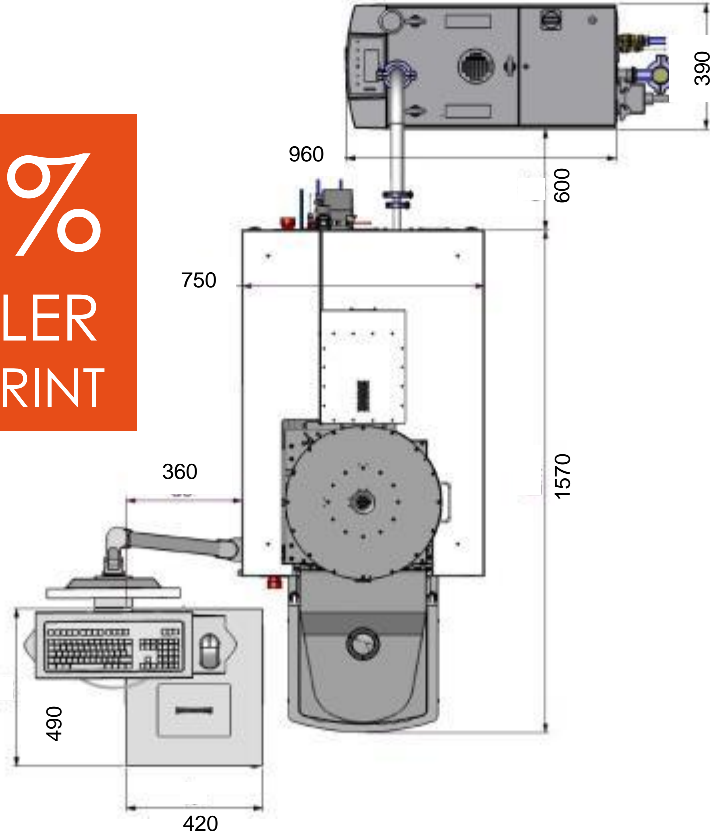
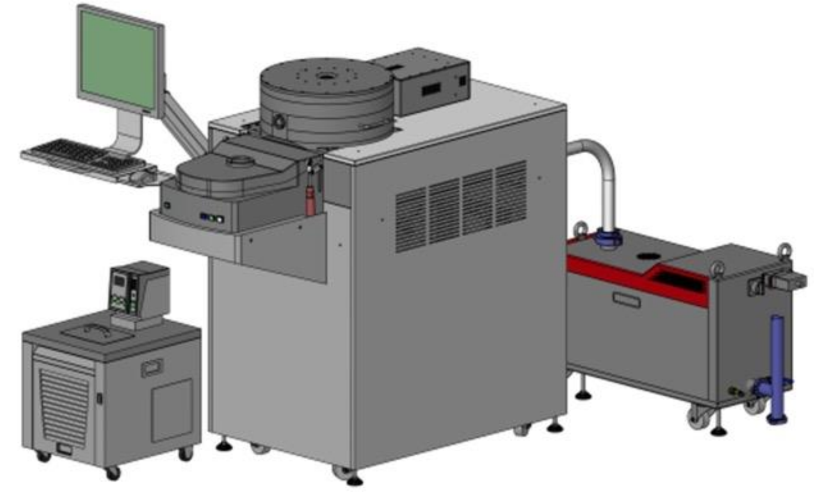
SYSTEM DESCRIPTION

General View

30 %
SMALLER
FOOTPRINT



THE MOST
COMPACT
MACHINE
ON THE MARKET



SYSTEM DESCRIPTION

Detailed View

EPD with laser

ICP reactor

Load lock

Chiller / Heater

2 kW ICP generator
(2 Mhz)

300 W RF generator
(13.56 Mhz)

Process controller

HV and LV power supplies

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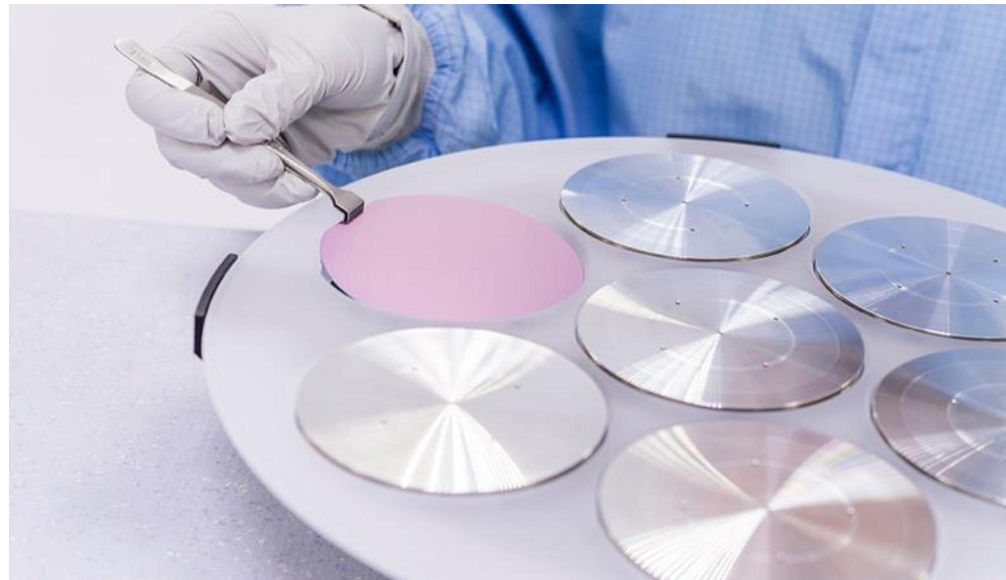
SYSTEM DESCRIPTION

Loading



< 180 s
LOADING TIME

Vacuum robot
FAST AND REPEATABLE LOAD AND UNLOAD

Shuttle
EASY EXCHANGE BETWEEN SUBSTRATE SHAPE AND SIZE

REACTOR
CORIAL 210D

CORIAL
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REACTOR

CORIAL's Latest Generation of Reactor

A WIDE RANGE OF APPLICATIONS

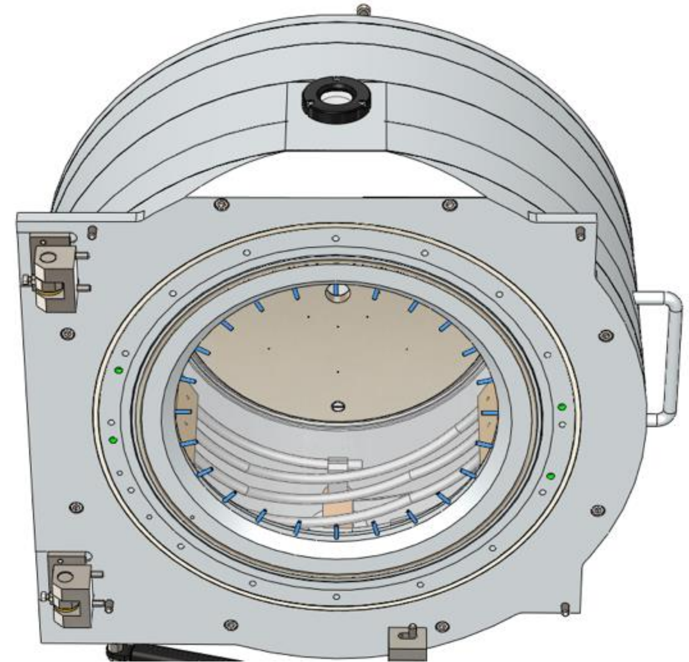
1. Low temperature ICP-CVD capabilities and RIE, ICP etching in the same tool
2. Optimized delivery of precursors for uniform film deposition (up to 6'') and etching (up to 8'')
3. High process flexibility with wide RF power operating range from 100 W to 2000 W
4. Reactor's hot walls enhance plasma cleaning efficiency and reduce particle load
5. Load lock for short pump-down times, stable and reproducible process conditions
6. Load lock to run fluorinated and chlorinated chemistries in the same machine
7. Retractable liner and shuttle holding to minimize process cross-contamination
8. Uniform wafer temperature ranging from 5°C up to 150°C (optionally from -50°C to 150°C)

REACTOR CONFIGURATION

Deposition Processes

Precursors (SiH_4, C_2H_4, dopants)and Ar are injected through the gas injector located close to the substrate holder

O_2, N_2 for deposition and process gasses for plasma cleaning are injected through the top gas shower

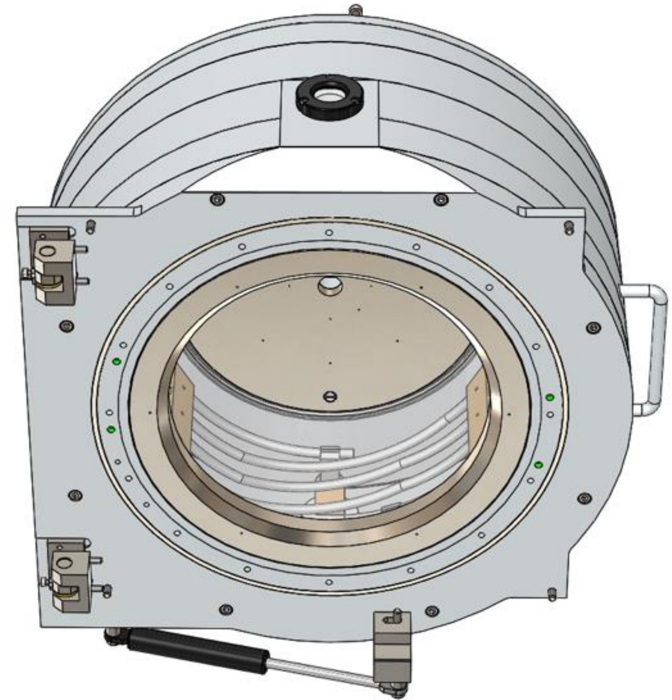


REACTOR CONFIGURATION

Etching Processes

Process gases are delivered using the top gas shower

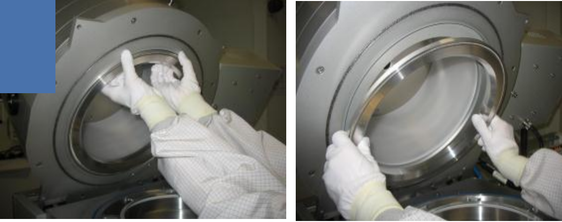
No gases are injected on the bottom of the reactor



REACTOR CONFIGURATION

Conversion etching to deposition mode

1



Etch liner removal after reactor venting and chamber opening

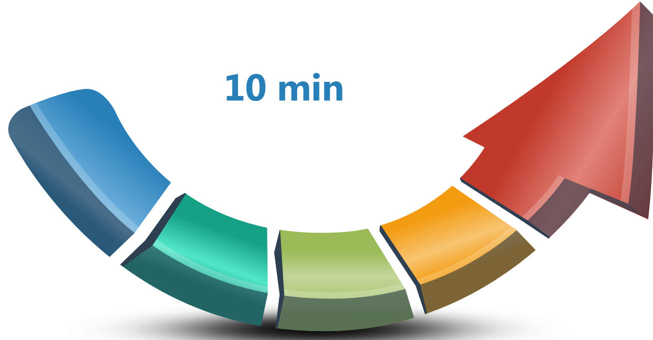
2

Deposition liner installation

3

Installation of the 24 quartz tubes in liner's holes

10 min



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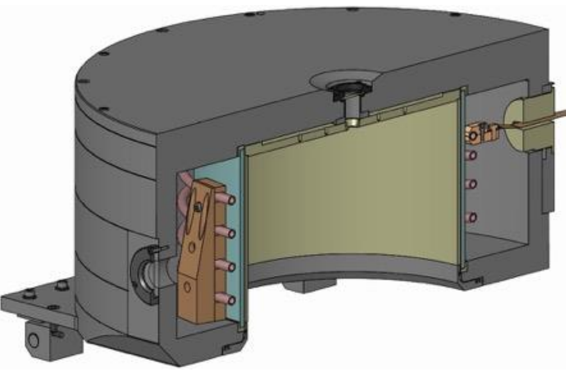
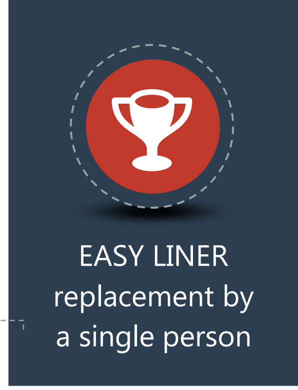
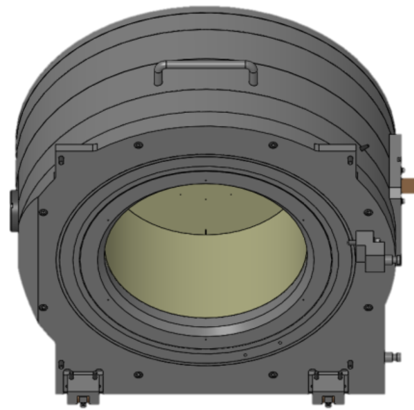
REACTOR CONFIGURATION

Retractable Quartz Liner

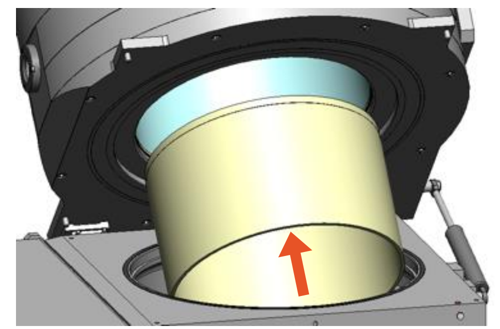


THE LINER FOR **HARSH ICP-RIE** PROCESSES





ZERO CROSS CONTAMINATION



Corial 210D

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REACTOR

Operation Sequence

Shuttle Loading

Loading tool

Shuttle

Cathode

CORIAL
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REACTOR

Operation Sequence

REACTOR

Operation Sequence

SHUTTLE HOLDING APPROACH
CORIAL 210D

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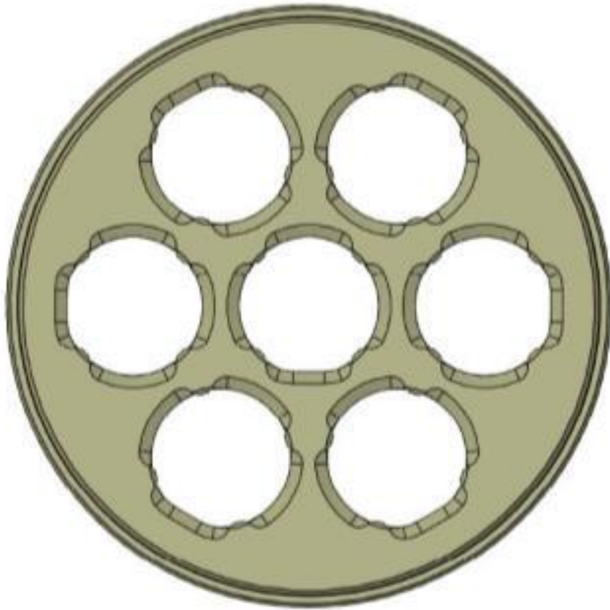
SHUTTLE HOLDING APPROACH

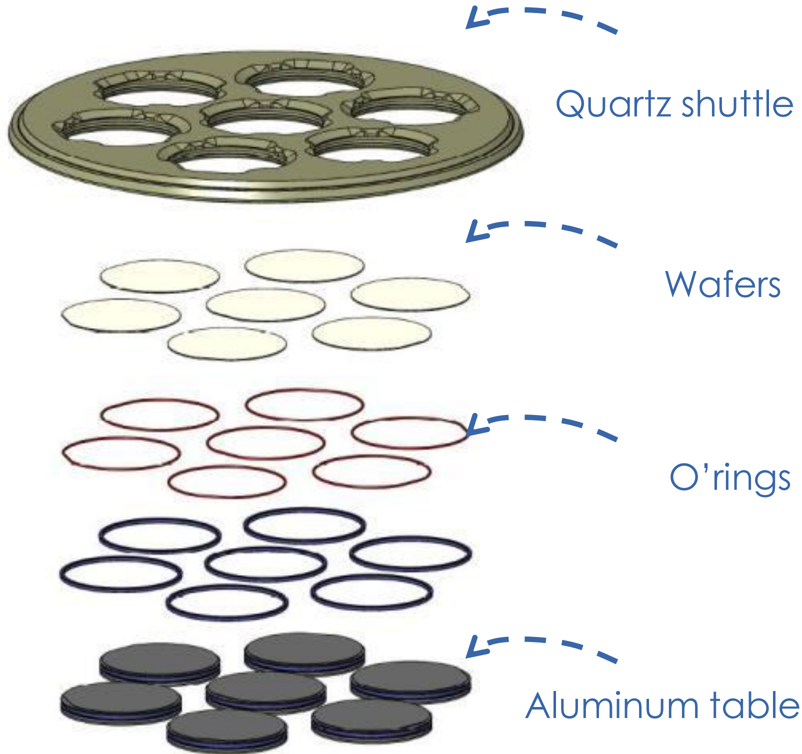
Benefits

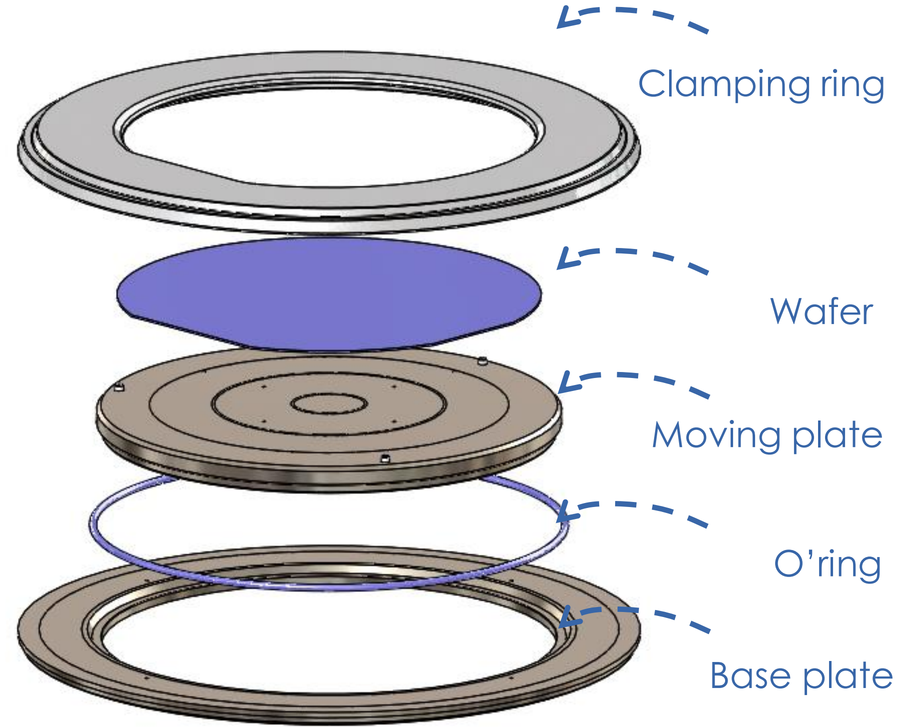


1. Quick adaptation to sample shape and size
2. Optimum process conditions with NO modification of process chamber
3. Limited cross contamination between processes by using dedicated shuttles
4. Shuttles for single wafer treatment: 1 x 2", 1 x 3", 1 x 4", 1 x 6", 1 x 8"
5. Shuttles for batch processing : 7 x 2", 3 x 3"
6. Customized shuttles are available (4" x 4", 5" x 5", etc)

SHUTTLE HOLDING APPROACH

Portfolio





Guaranteed no wafer damage due to SOFT wafer clamping

PERFORMANCES DEPOSITION PROCESSES

CORIAL 210D

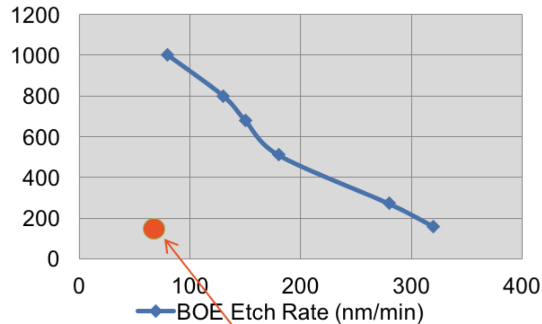
ICP-CVD APPLICATIONS

Deposition of high quality SiO_2, Si_3N_4, SiOCH, SiOF, SiC and aSi-H films at low temperature (from 20°C to 150°C)

	ICPCVD	PECVD
Film quality	High quality at temp < 150°C	High quality at temp > 250°C
Defects in the film	-	No pinholes
Maximum thickness	1.5 µm	100 µm
Reactor cleaning	In situ + manual cleaning (after deposition of > 50 µm)	In situ (automated plasma cleaning)
Applications	R&D	Low to medium volume fabrication and R&D

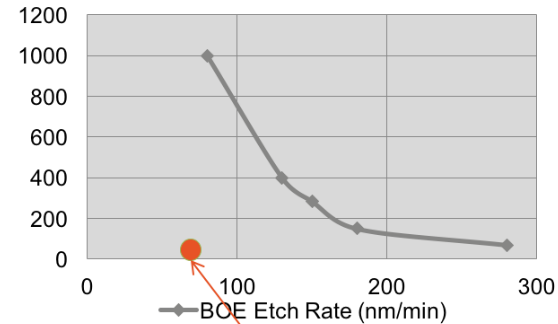
ICP-CVD APPLICATIONS

SiO_2 Wet etch rates



Temperature (°C)	ICP-CVD (nm/min)	PECVD (nm/min)
70	190	/
80	/	1000
130	/	800
150	/	680
180	/	510
280	/	270

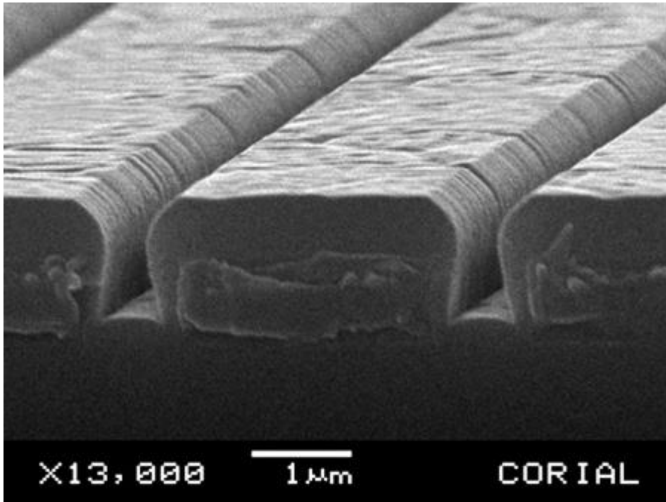
SiN_x Wet etch rates



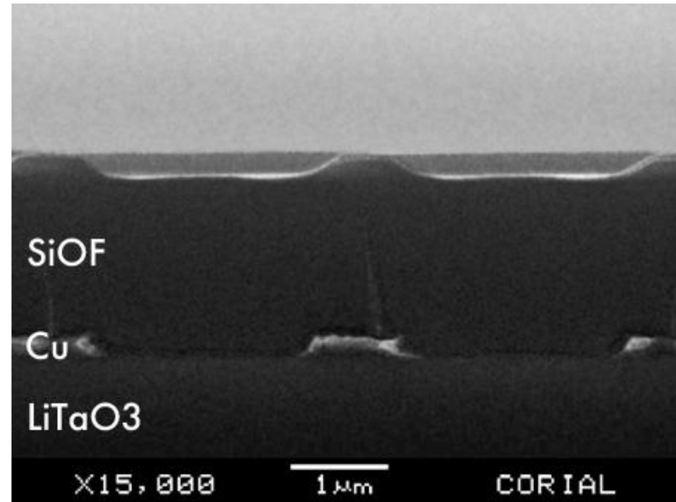
Temperature (°C)	ICP-CVD (nm/min)	PECVD (nm/min)
70	40	/
80	/	1000
130	/	400
150	/	285
180	/	150
280	/	70

ICP-CVD STEP COVERAGE

SiH_4 Chemistry



Coverage of ICP-CVD SiO_2 on Al step



Self-planarized deposition of SiOF on Cu

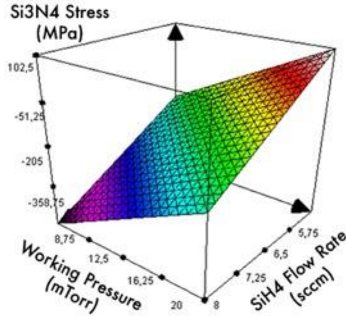
PROCESS PERFORMANCES

High Quality Films

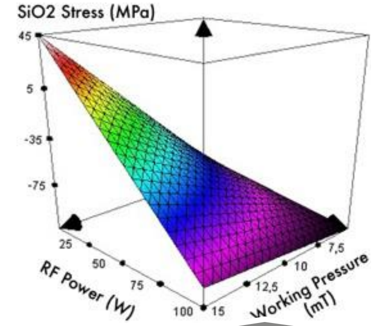
Material	Wafer size	Process Temp (°C)	Dep.Rate (nm/min)	Uniformity (%)	Refractive index	Stress (MPa)
SiO_2	6"	70	115	2.17	1.47	-71
Si_3N_4	3"	70	135	0.9	1.83	-175
Si_3N_4	6"	70	97	2.81	1.86	-220
SiO_xN_y	6"	70	116	±2.73	1.60	-133
a-SiH	3"	70	49	-	3.8	-198
SiON	4"	70	125	-	1.59	-150
SiO_2	3"	no wafer clamping (wafer at 230°C)	110	0.6	1.47	-227

PROCESS PERFORMANCES

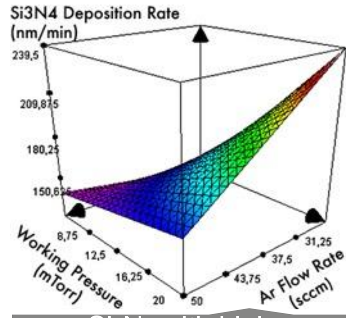
High Quality Films



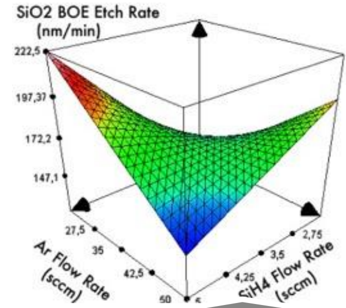
Si_3N_4 with tunable stress



SiO_2 with tunable stress

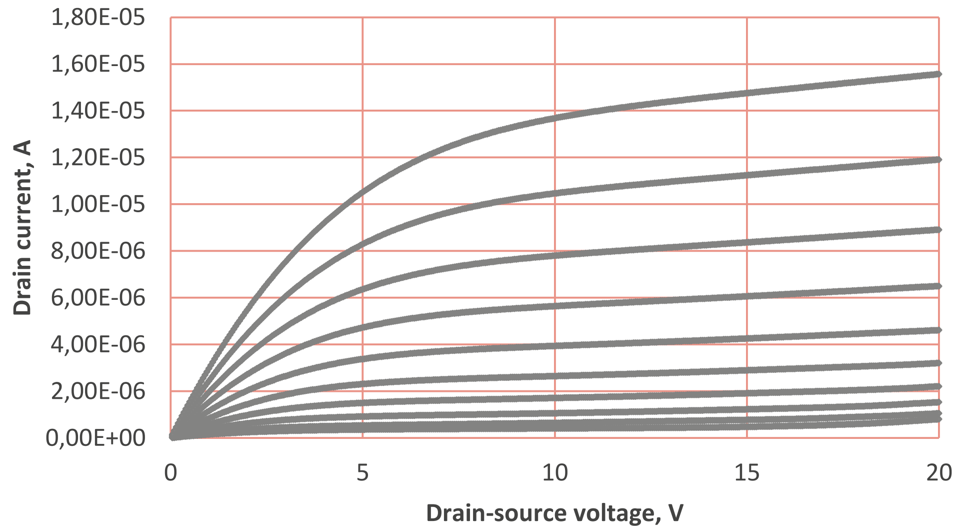


Si_3N_4 with high deposition rate



SiO_2 with Low BOE Etch Rate

TFT transistors can be made with a single Corial 210D ICPCVD tool
Deposition of active layers (a-Si doped by PH3 and B2H6) and dielectrics followed by patterning performed by Corial 210D



Example of a TFT transistor performances for various gate voltage

PERFORMANCES ICP-RIE PROCESSES
CORIAL 210D

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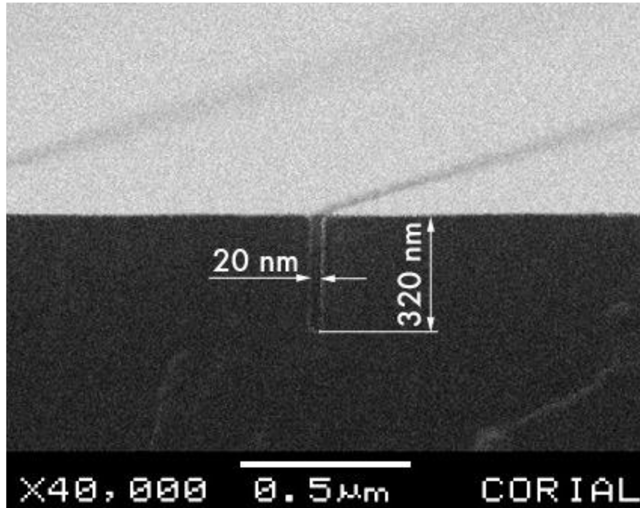
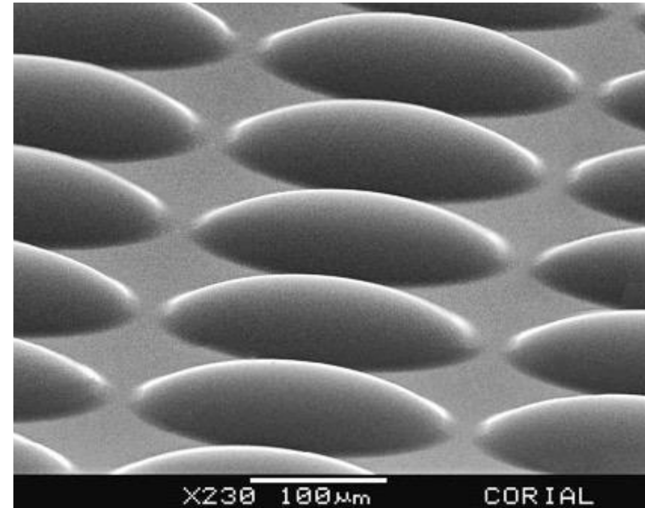
ICP-RIE OF SI

Fluorinated chemistry



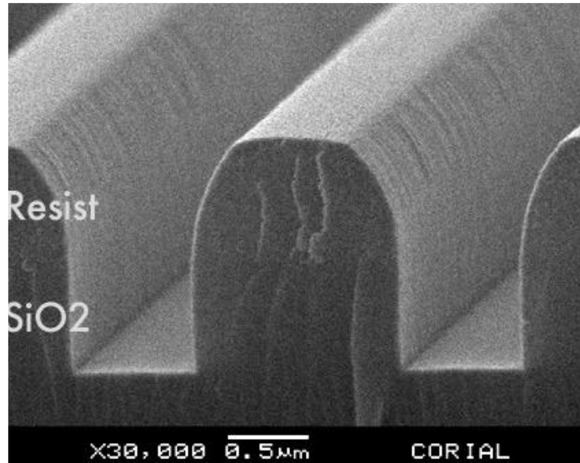
High Resolution ICP-RIE of Si



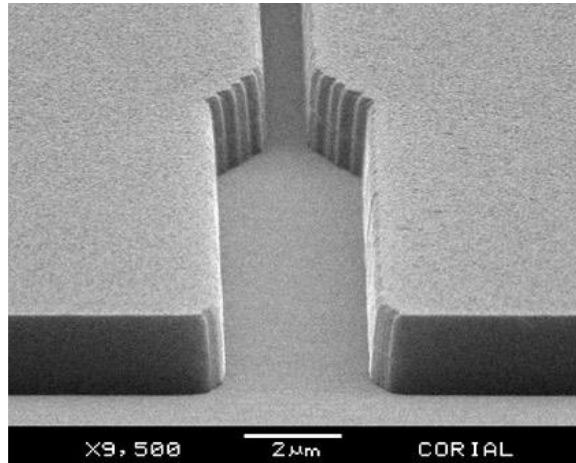
ICP-RIE of Si microlenses 40 µm high

ICP-RIE OF OXIDES AND NITRIDES

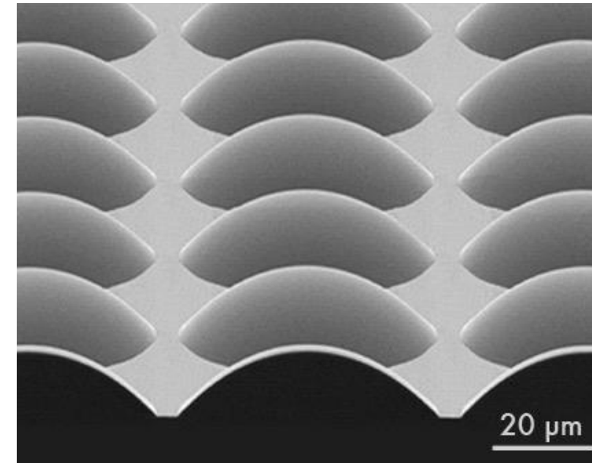
Fluorinated chemistry



ICP-RIE of SiO_2



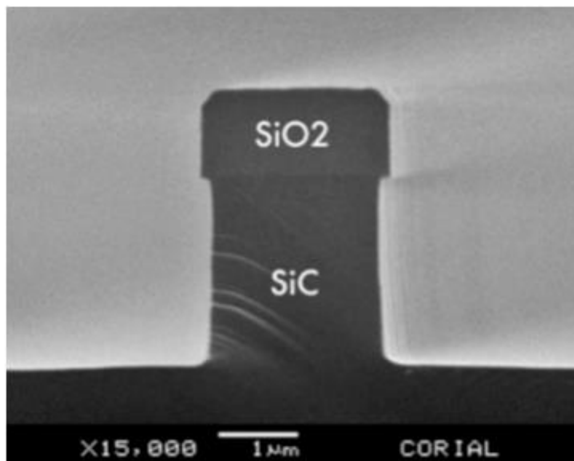
ICP-RIE of Si_3N_4



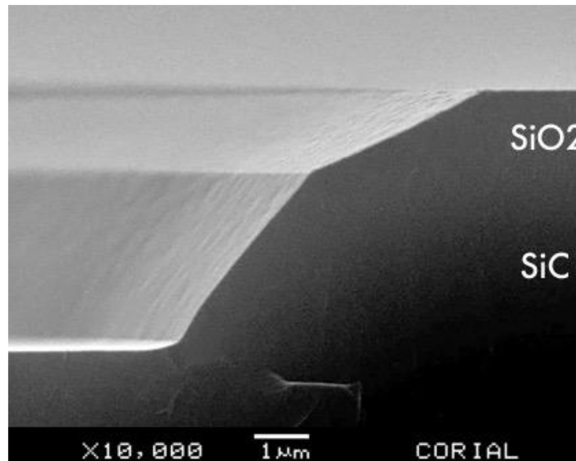
ICP-RIE of SiO_2 Microlenses

ICP-RIE OF HARD MATERIALS

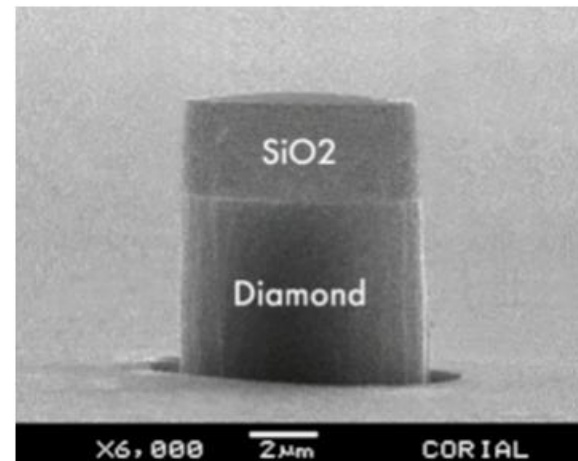
Fluorinated chemistry



ICP-RIE of SiC
With no trenching



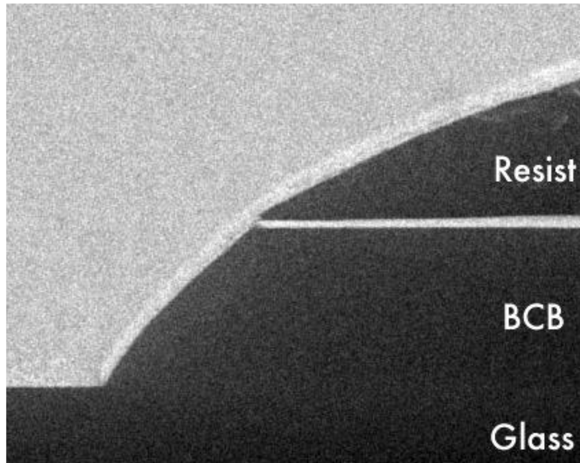
Tapered ICP-RIE of SiC



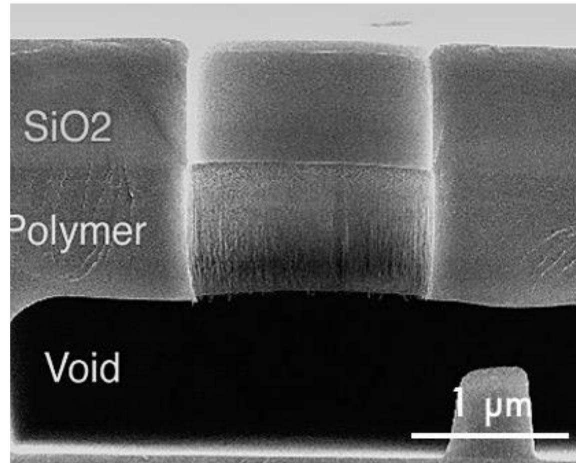
ICP-RIE of Diamond

Corial 210D

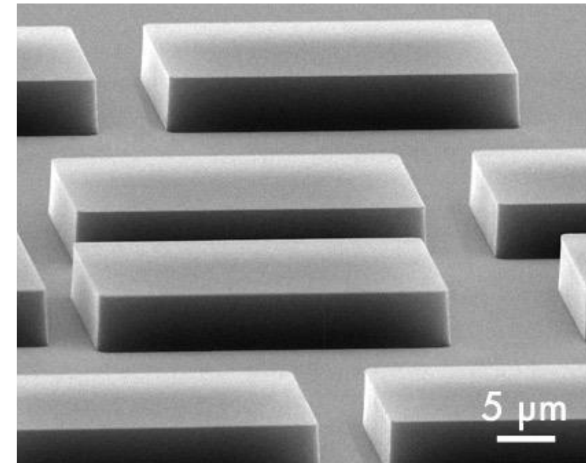
ICP-RIE OF POLYMERS



BCB etching with PR mask



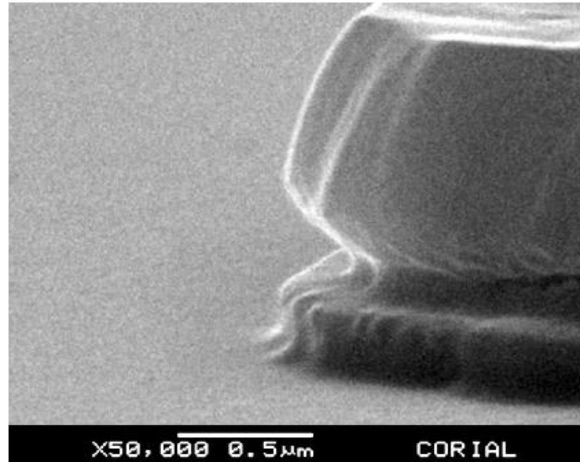
ICP-RIE of Polyimide



Anisotropic etching of Polyimide with SiO2 mask

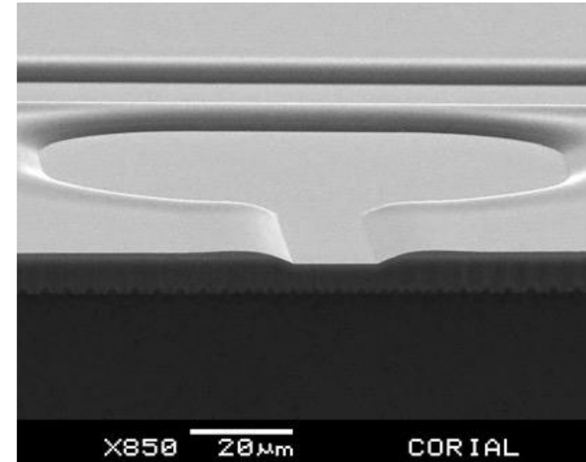
ICP-RIE OF III-V COMPOUNDS

Chlorinated chemistry



Low damage ICP-RIE of GaN

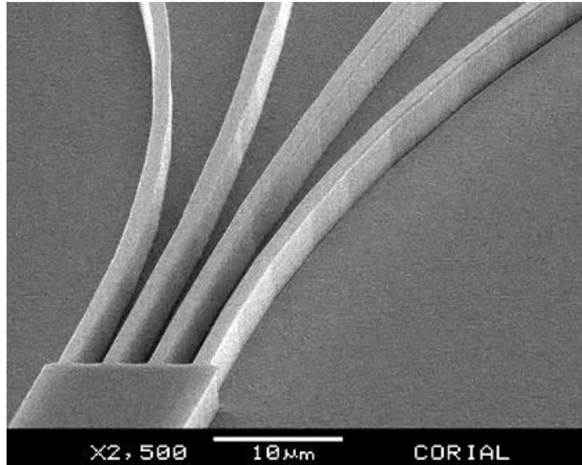
VCSEL



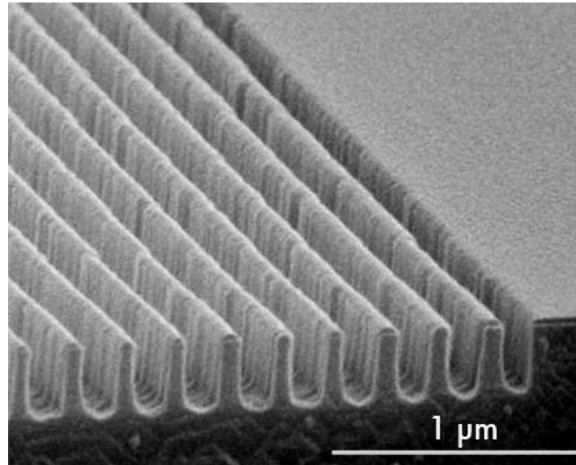
ICP-RIE of GaN (Mesa)

ICP-RIE OF III-V COMPOUNDS

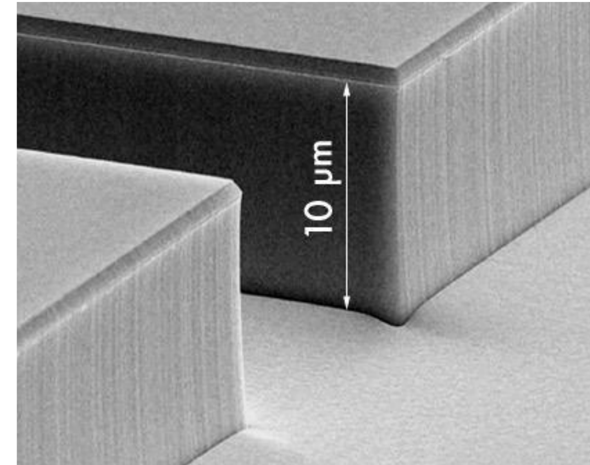
Chlorinated and hydrocarbon chemistry



ICP-RIE of InP



RIE of InP 0.1 µm lines and spaces



Deep RIE etching of InP

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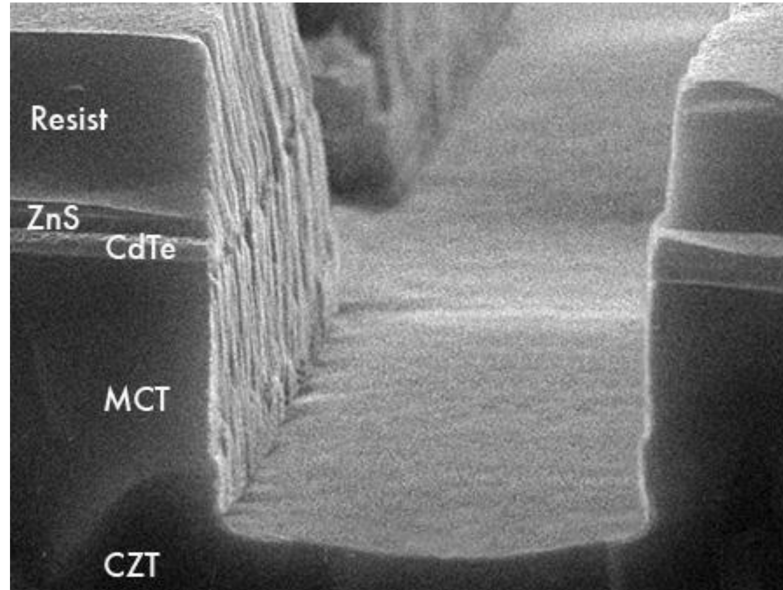
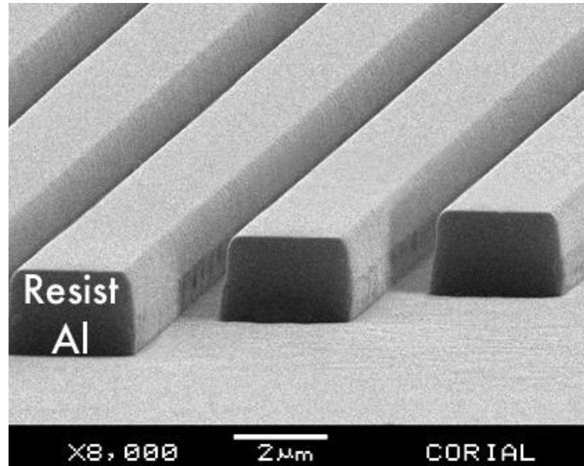
Corial 210D

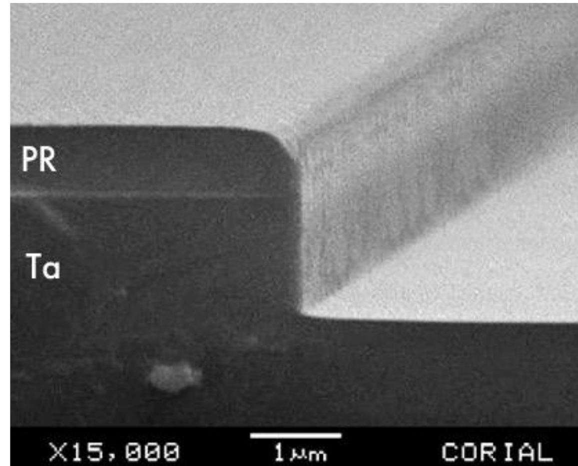
ICP-RIE OF II-VI COMPOUNDS



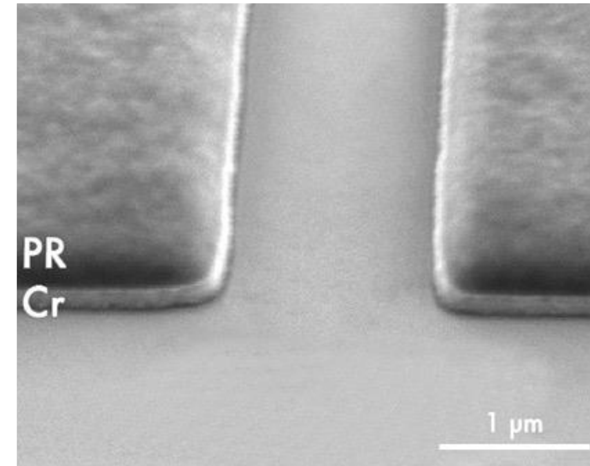
ICP-RIE OF METALS



ICP-RIE of Al



ICP-RIE of Ta



ICP-RIE of Cr

PROCESS PERFORMANCES

High Etch Rates & Excellent Uniformities

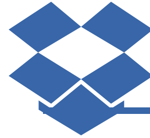
Process	Mask	Etch rate (nm/min)	Selectivity (vs mask)	Uniformity (across wafer)
Polymers	PR	800	1	±5%
SiO_2	PR	400	> 3	±3%
Si_3N_4	PR	350	> 4	±3%
Diamond	SiO2	500	> 25	±3%
Cr	PR	60	0.8	±3%
InP	SiO2	1200	> 25	±3%
InSb	SiO2	250	> 6	±3%
GaN (Mesa)	PR	600	1	±3%
GaN (Iso)	PR	1200	> 1	±3%
ZnS	PR	100	> 1	±3%
CdTe	PR	300	> 2	±3%
MCT	PR	500	> 4	±3%

USABILITY
CORIAL 210D

CORIAL
A Plasma-Therm Company

PROCESS CONTROL SOFTWARE

COSMA



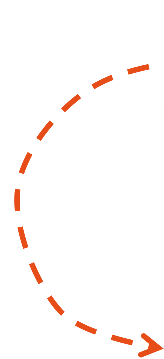
COSMA

CORIAL **O**PERATING **S**YSTEM FOR **MA**CHINE

The simplest, most efficient software to develop processes, operate, and maintain CORIAL systems

DESKTOP APPLICATION

Process Editing ı Process Adjustment ı Process Operation ı Process Tracability ı System Maintenance



REMOTE CONTROL

REPROCESSING SOFTWARE

COSMA RS

DISPLAY UP TO

4

PARAMETERS FROM A RUN

Simple and efficient software to analyze process runs and accelerate process development

REMOTE

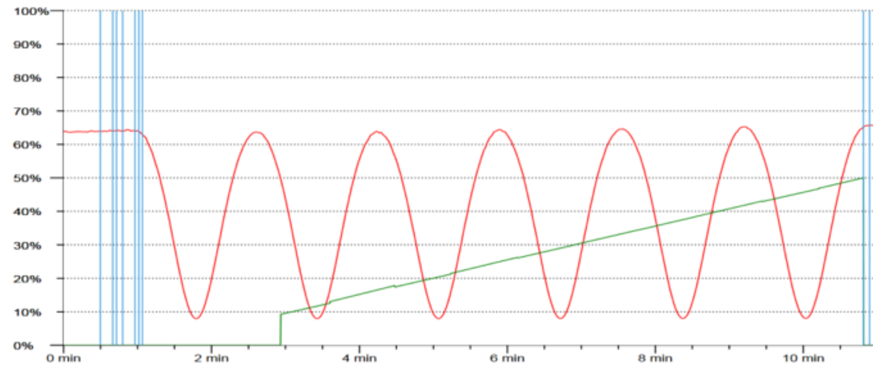
ANALYSIS OF RUNS

DRAG AND DROP

CURVES TO CHECK PROCESS REPEATABILITY

END POINT DETECTION

EPD with laser



A CCD camera and laser diode, in the same measuring head, enables simultaneous visualization of the wafer surface and the laser beam impact on it. A 20 µm diameter laser spot facilitates the record of interference signals.

Real-Time etch rate measurement
Real-Time etched depth measurement

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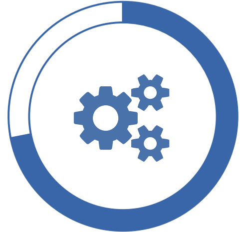
CORIAL 210D

High quality films deposition at low temperature



SiO_2, Si_3N_4, SiOF, SiOCH, aSi-H, SiC deposition at low temperature (20°C to 150°C)

Reactor flexibility to accommodate a wide range of customer applications in RIE, ICP-RIE, and ICP-CVD modes

Adaptable to a wide range of substrate sizes:
wafer pieces, 1x2'' to 7x2'' ; 1x3'' to 3x3'' ; 1x4'' ; 1x6''