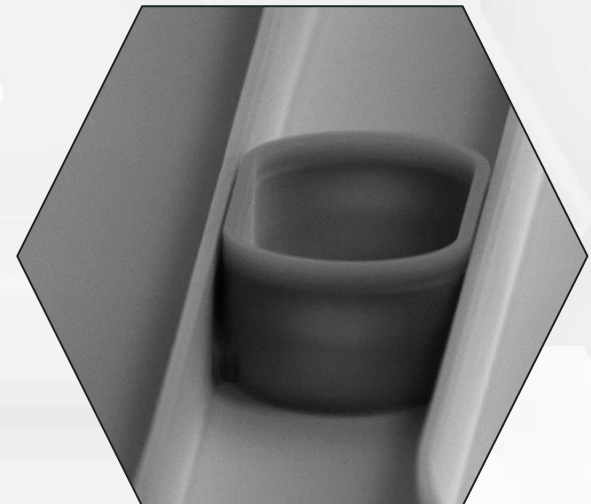




ELECTRONICS AND PHOTONICS: OVERLAPPING PLASMA PROCESSING REQUIREMENTS

November / 2023



- Company introduction
- End users' applications and Plasma processes requirements and solutions
 - Etch
 - Deposition
- Plasma process use case for hybrid package solution
- Conclusion



Etch

ICP – High density plasma
RIE – Low density plasma
DSE™ – Deep Reactive Ion Etch
IBE – Ion Beam Etch
ALE – Atomic Layer Etching
HDRF – Remote plasma



Deposition

PECVD, HDPCVD, LAPECVD
PVD – Sputtering
IBD – Ion Beam Dep
F.A.S.T. – Fast Atomic Sequential Technology



Thermal Processing

RTP – Anneal, Oxidation, Activation, Silicides



Dicing

PDOT – Plasma Dicing on Tape
PDOC – Plasma Dicing on Carrier
PDBG – Plasma Dicing Before Grind



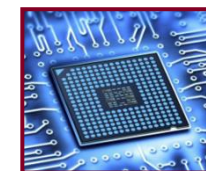
Photonics

AR/VR and Displays. μ LEDs
VCELS & Optoelectronics



Wireless & Connectivity

5G, RF Filters, BAW, SAW, BAR,
PA, IoT, Mobility



Semiconductor & Advanced Packaging

Logic & Memory,
IDM, Foundry, OSAT



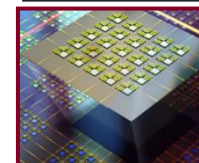
Power Devices

Power Electronics, Wide-Bandgap
Energy & Battery Technology



Memory & Storage

HDD, MRAM & NVM
Big Data & Edge



Sensors & MEMS

Image Sensors, LiDAR,
Actuators. Life Sciences

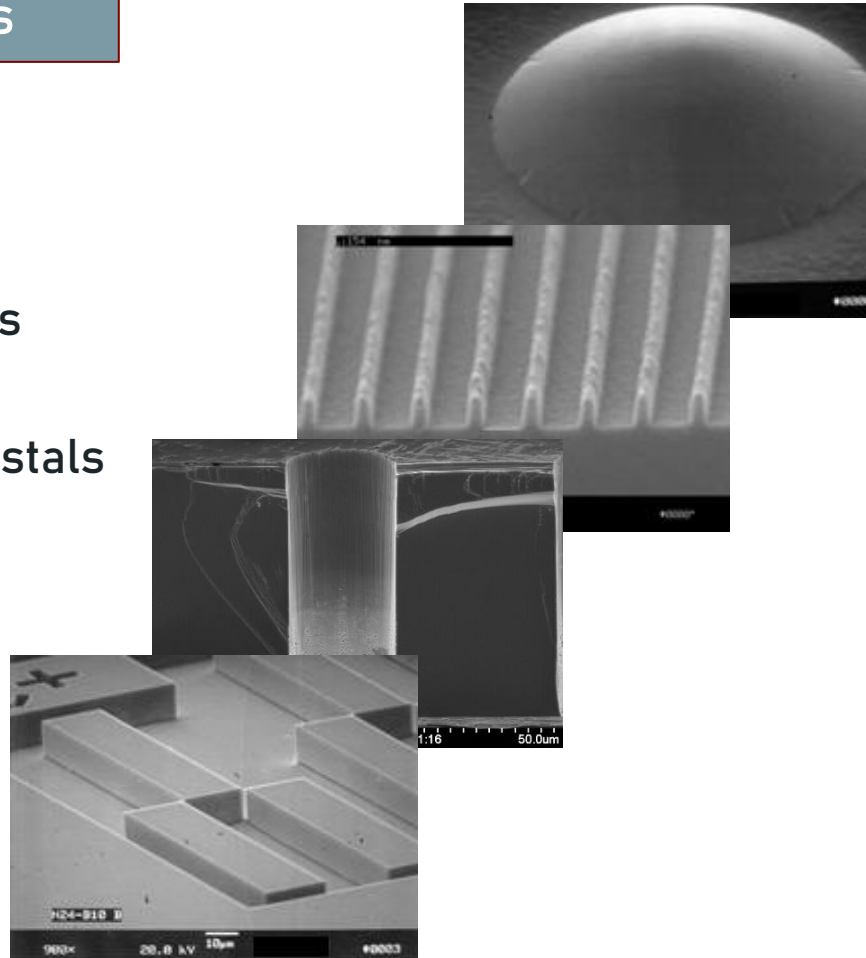


Scientific & R&D

Universities, Research
Institutions, Governments

Applications/Devices

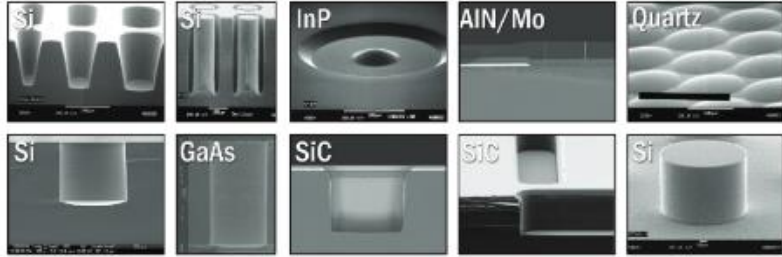
- Photonics
 - Lasers
 - Gratings
 - Micro-lenses
 - Optics
 - Photonic crystals
 - Detectors
 - VCSELs
 - LEDs
 - Solar cells
- Electronics
 - HBTs
 - HEMTs
 - Diodes



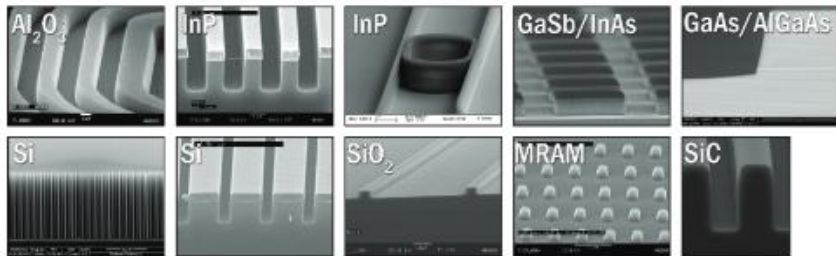
Processes

- Deposition:
 - Hardmasks for etching (e.g., InP)
 - Waveguide cladding
 - Hydrophobic barrier layers
 - Bragg mirrors (e.g., TiO_x/SiO_x)
 - Transparent conductors (e.g., ZnO)
 - Contacts Ohmics, Shottk
 - Conformal
 - Passivation
- Etching
 - Profile control (sloped, vertical)
 - Damage considerations
 - Slow and fast rates
 - Selectivity between layers

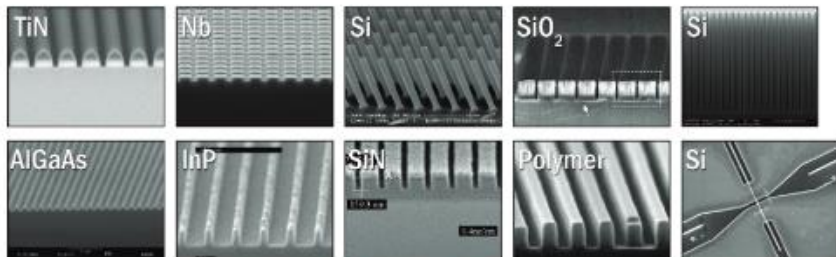
TECHNOLOGY FROM NANO TO MACRO



> 5 to 500 um features



0.1um to 5 um features

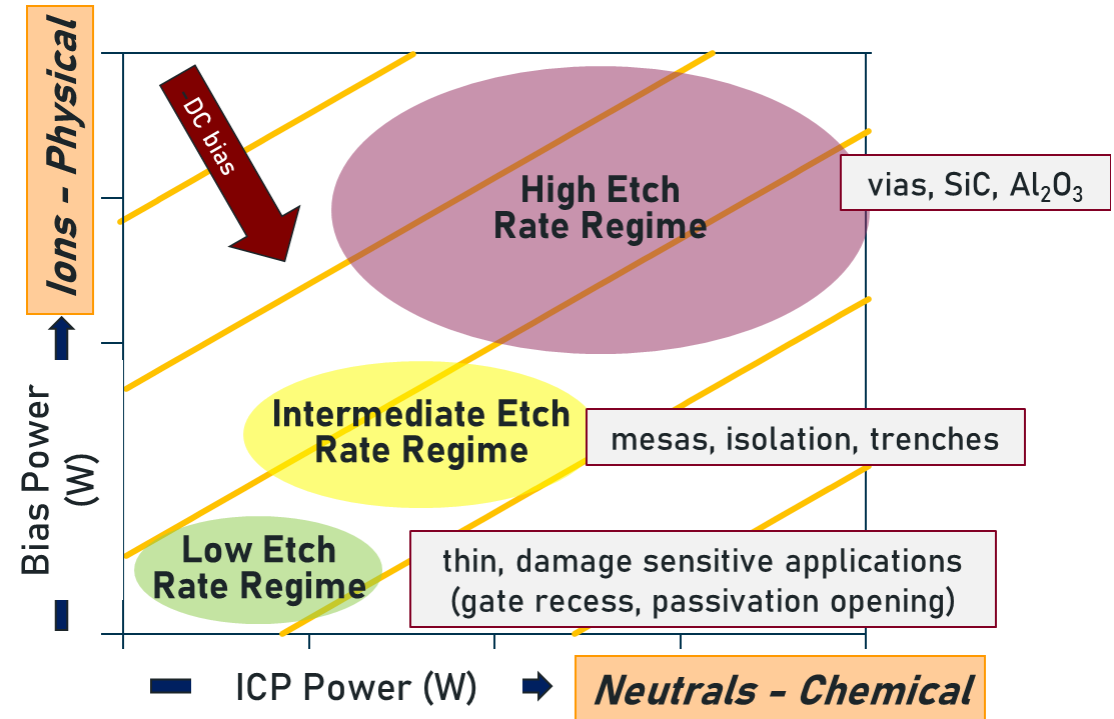


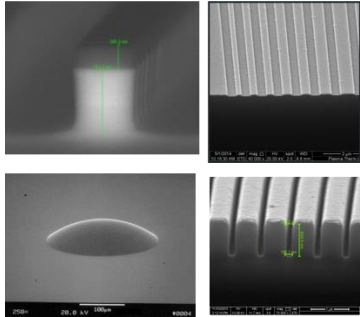
<0.1 um features

Structures: nanoscale to macro, sloped to vertical
Gratings to vias and micro-lenses

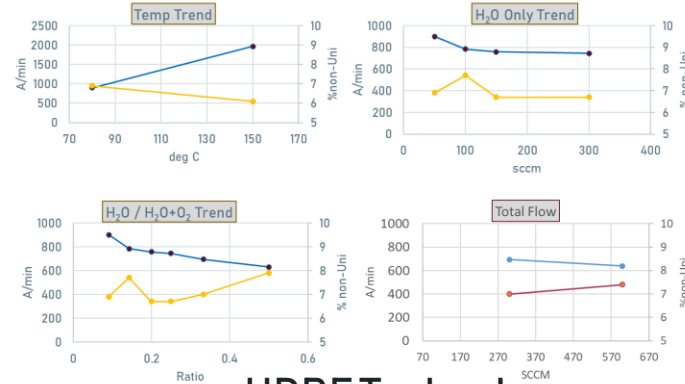
Materials: spanning wide property range
III-Vs, SiC, Si, metals, dielectrics, DLC, piezo materials

Processes ranging from slow, controllable, low damage to high rate
Endpoint, cleaning, stripping, ion beam, wide temperature ranges

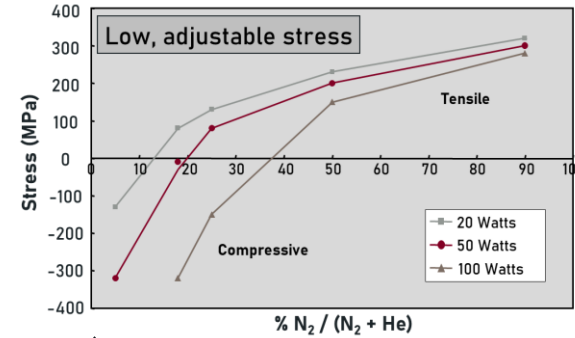




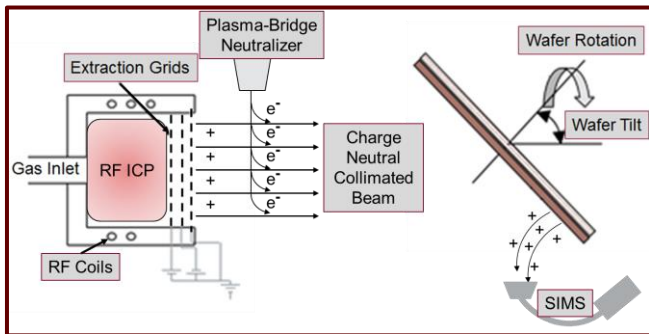
VERSALINE ICP Technology
Dielectric etching, Metals
Compound semiconductors



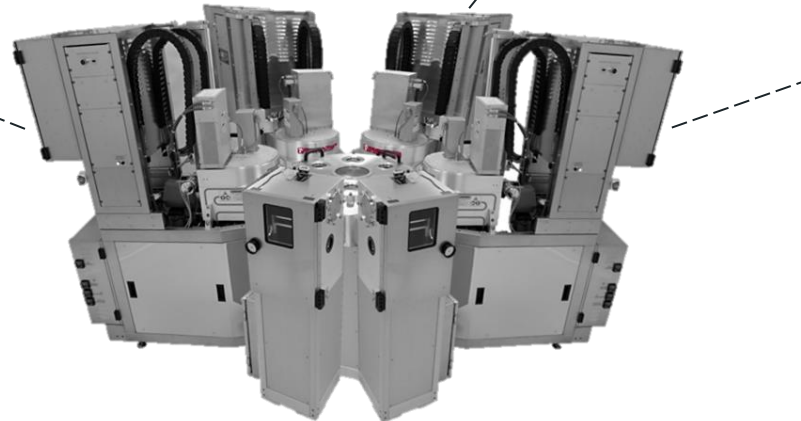
HDRF Technology
PR & Polymer Strip
(w/ or w/o H₂O)



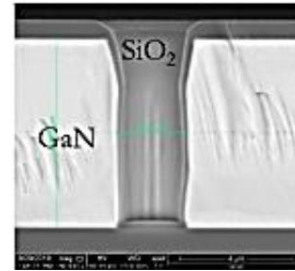
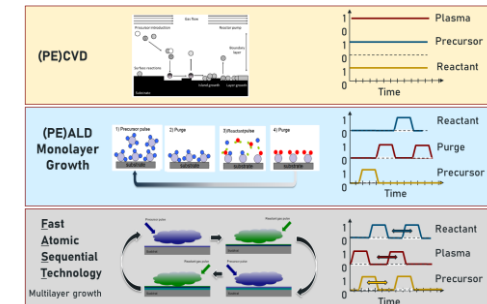
PECVD, HDPCVD Technologies
Low to High Rate
Low to High Temperature
Low damage stress control



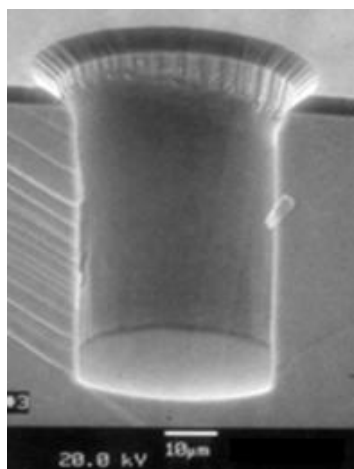
IBE Technology
Metals, Piezo Materials



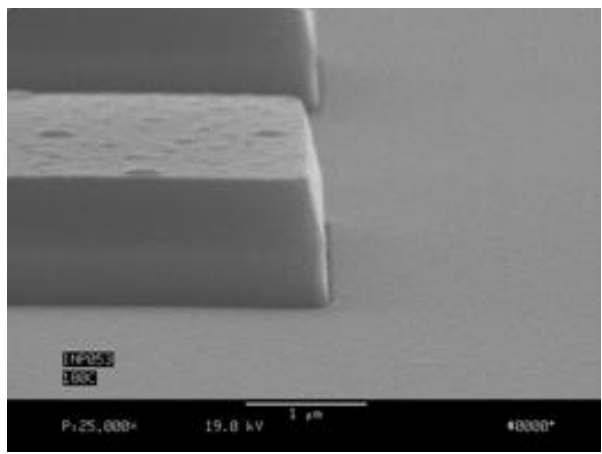
4-, 6- or 8-Sided Cluster Systems
Cassette-to-Cassette



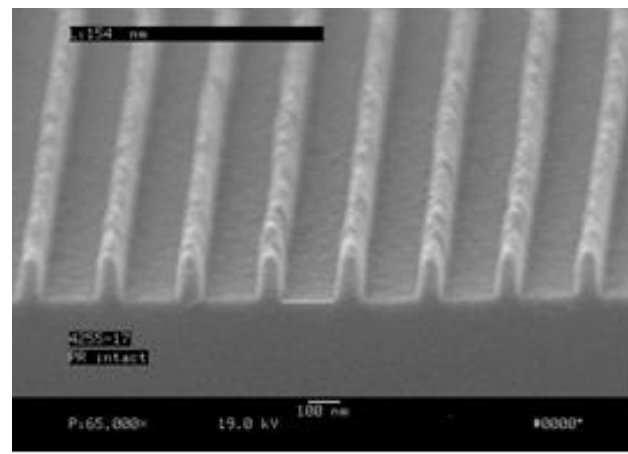
FAST Technology
High rate and conformal



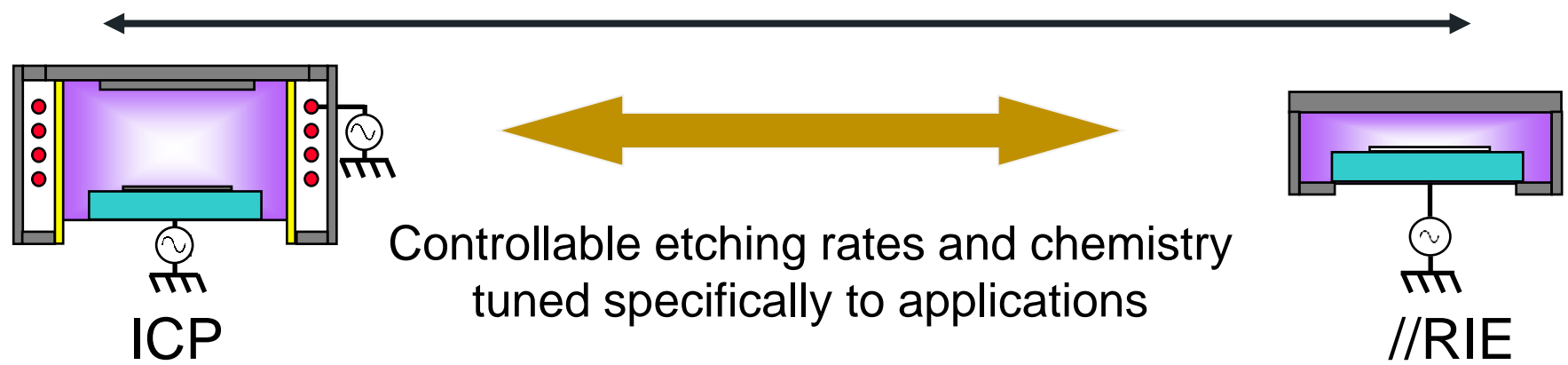
~10 μm/min



~0.1 μm/min



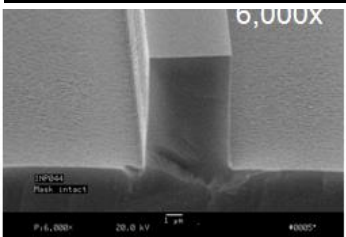
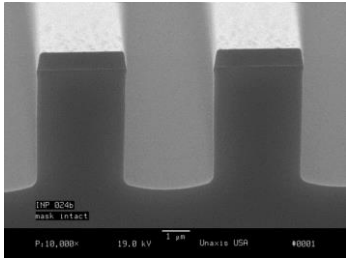
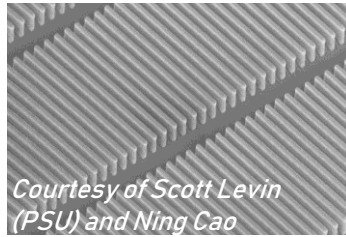
~0.01 μm/min



InP Based Lasers & Modulators

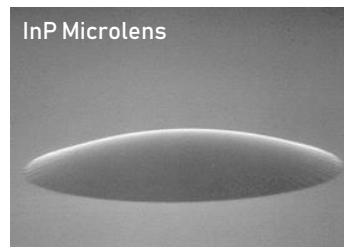
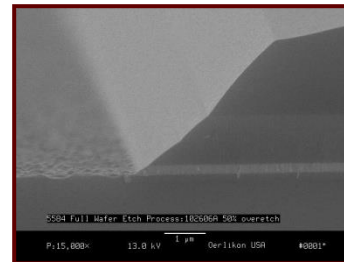
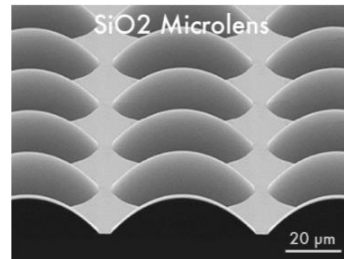
- Vertical profiles
- High aspect ratio
- Smooth sidewalls for low loss

(Requires high temperatures and hardmask)



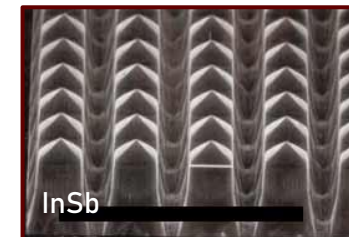
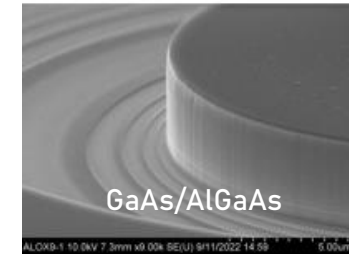
Profile Control

- Selectivity control
- Sloped profiles
- Smooth for low loss



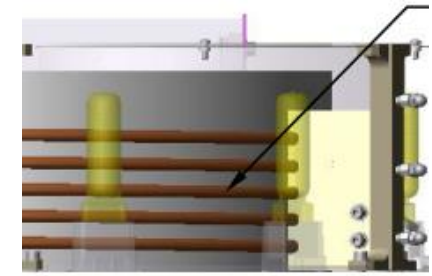
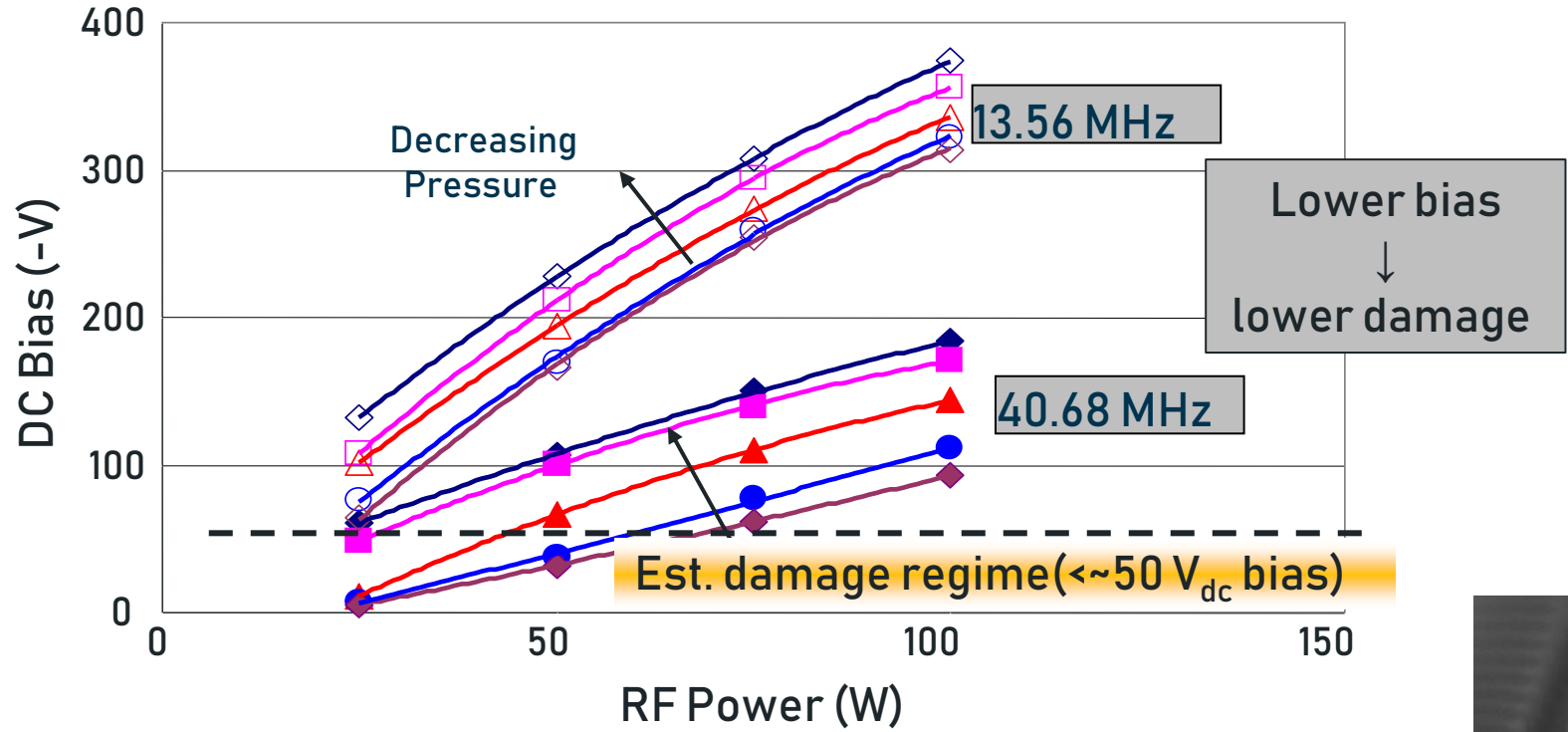
Material Range

- Selectivity between materials
- Low damage
- Controllable rate
- Controllable profiles

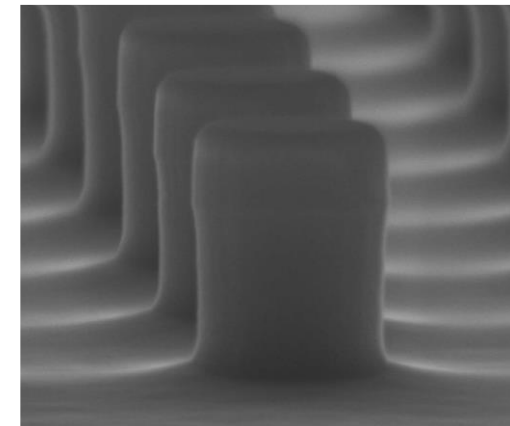
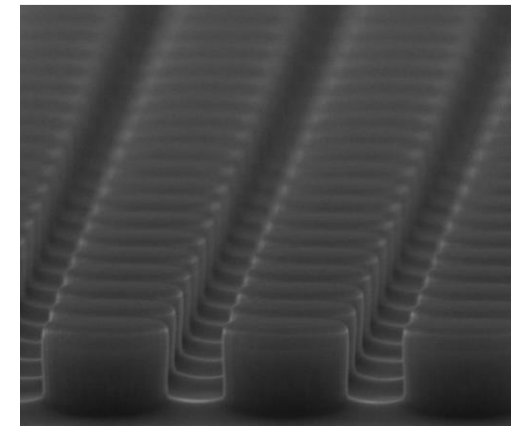


Slow, Controllable

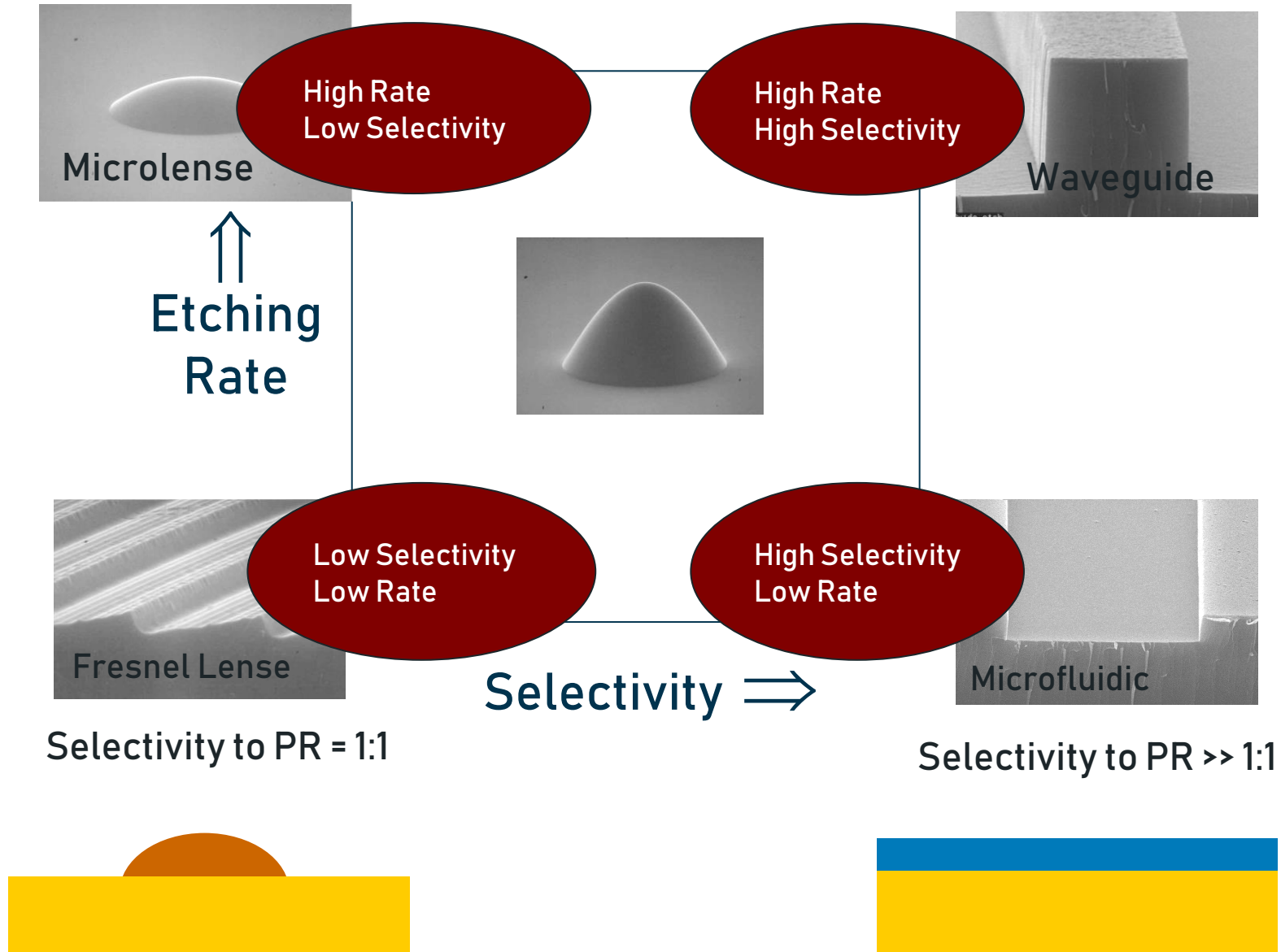
- 40 MHz allows operation at higher RF power maintaining lower bias in low pressure regime (better uniformity)



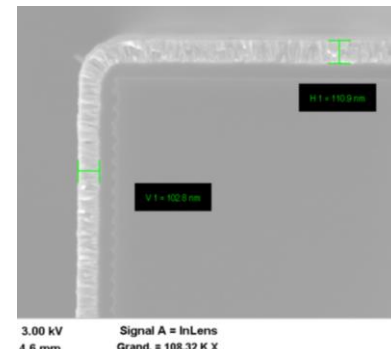
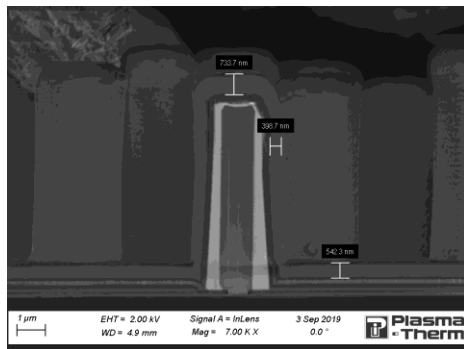
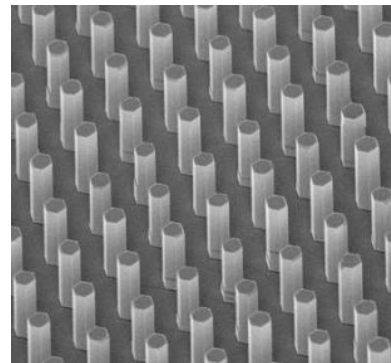
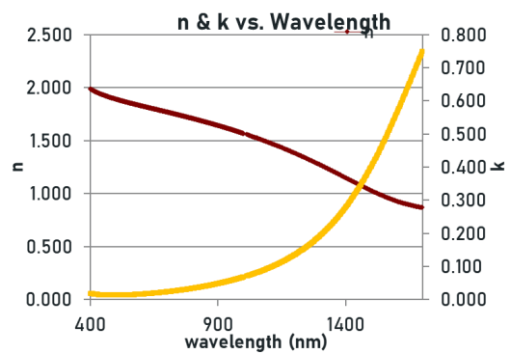
Lowpower ICP operation with multi-turn coil



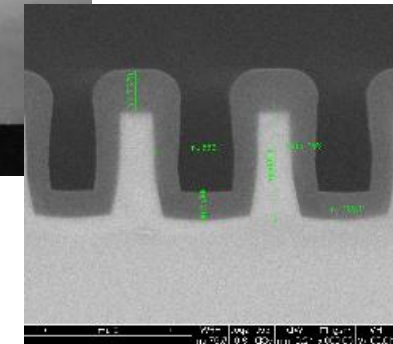
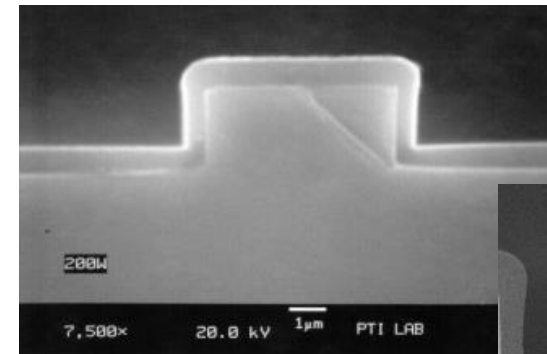
1 μm features InGaP/AlInGaP Etch on GaAs



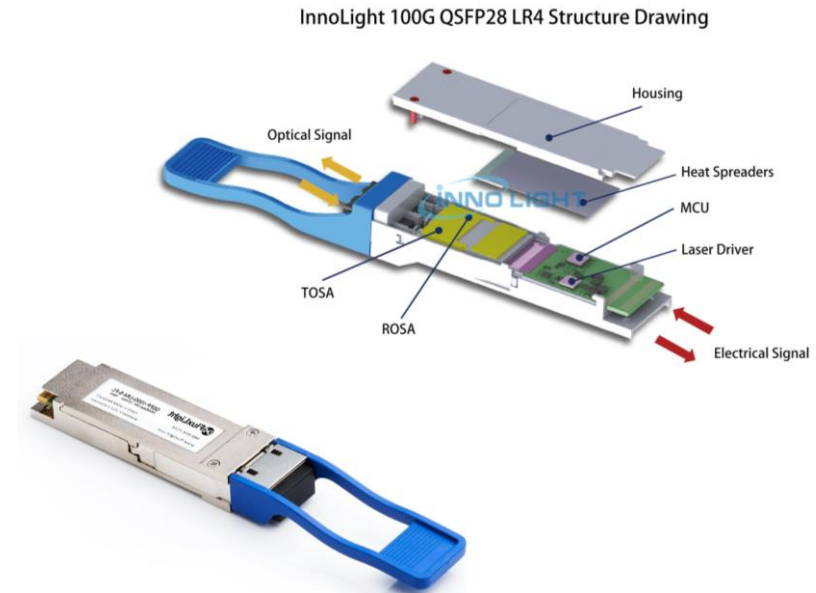
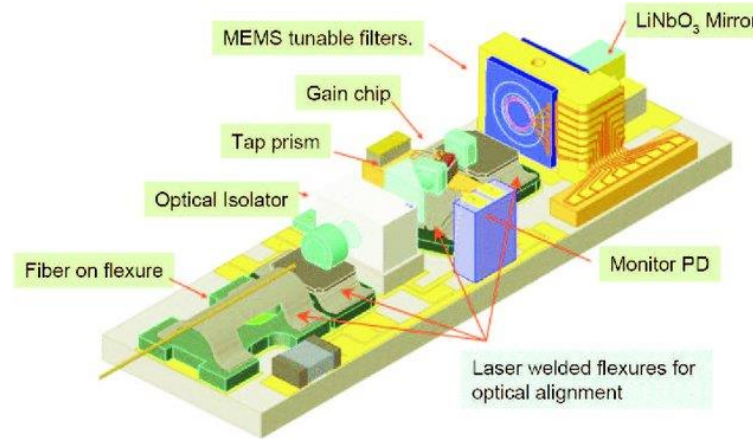
- ZnO – Transparent Conductive Layer
 - Fast Atomic Sequential Technology - F.A.S.T.
 - Ideal for thick and conformal layers
 - High deposition rate



- Dielectrics with PECVD and HDPCVD
 - Index control
 - Surface passivation
 - Stress control
 - High deposition rate



- Plasma deposition providing protection against harsh environmental exposure, including salt fog and sand and dust exposure.



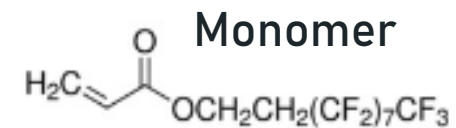
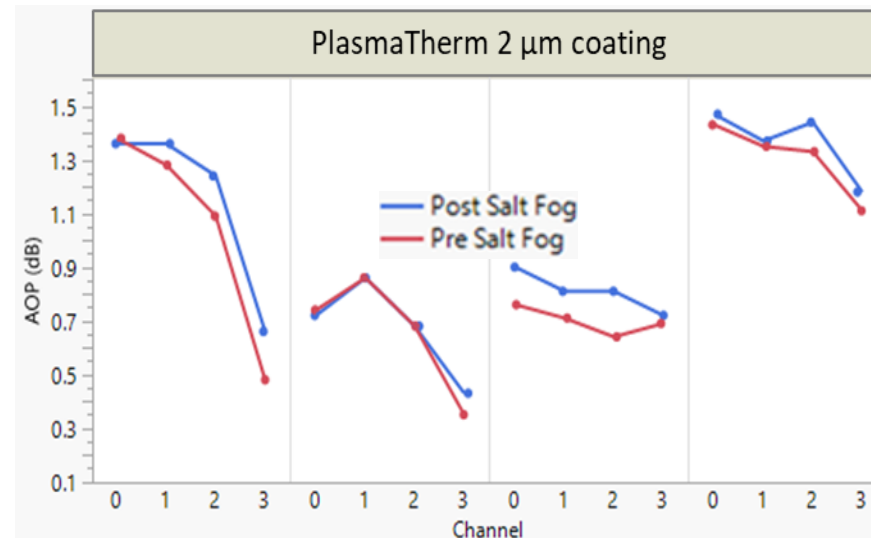
- Challenge: Complicated and multiple materials (PCB, thermoplastics, epoxies, metal, SMT components, optical fibers)

- Test vehicle: FireFly™ an on-board high-speed data communications optical transceiver
 - Applications: mil/aerospace, automated test equipment, ASIC, supercomputing, Industrial & medical

- Requirements
 - IPC Class 3
 - Conformal Coating
 - Resistant to Fretting
 - Vibration Tolerant
 - Salt Fog Protection
 - Extreme Humidity
 - Sand and Dirt Protection
 - Extreme Temperature Operation
 - Tin Whisker Mitigation
 - Resistant to Fungus

- Performance:
 - No degradation in optical power after 48 hours salt fog exposure

Courtesy of

- Phononics applications have become mainstream thanks to advanced packaging / more than Moore industry trend
 - Plasma processing (etching, deposition, surface preparation/cleaning, plasma dicing) developed for various mainstream applications benefit to Photonics industry
- We have global interaction with microelectronic industry and are here to help with
 - Research projects (internal and collaborative)
 - Solutions from academic to volume production

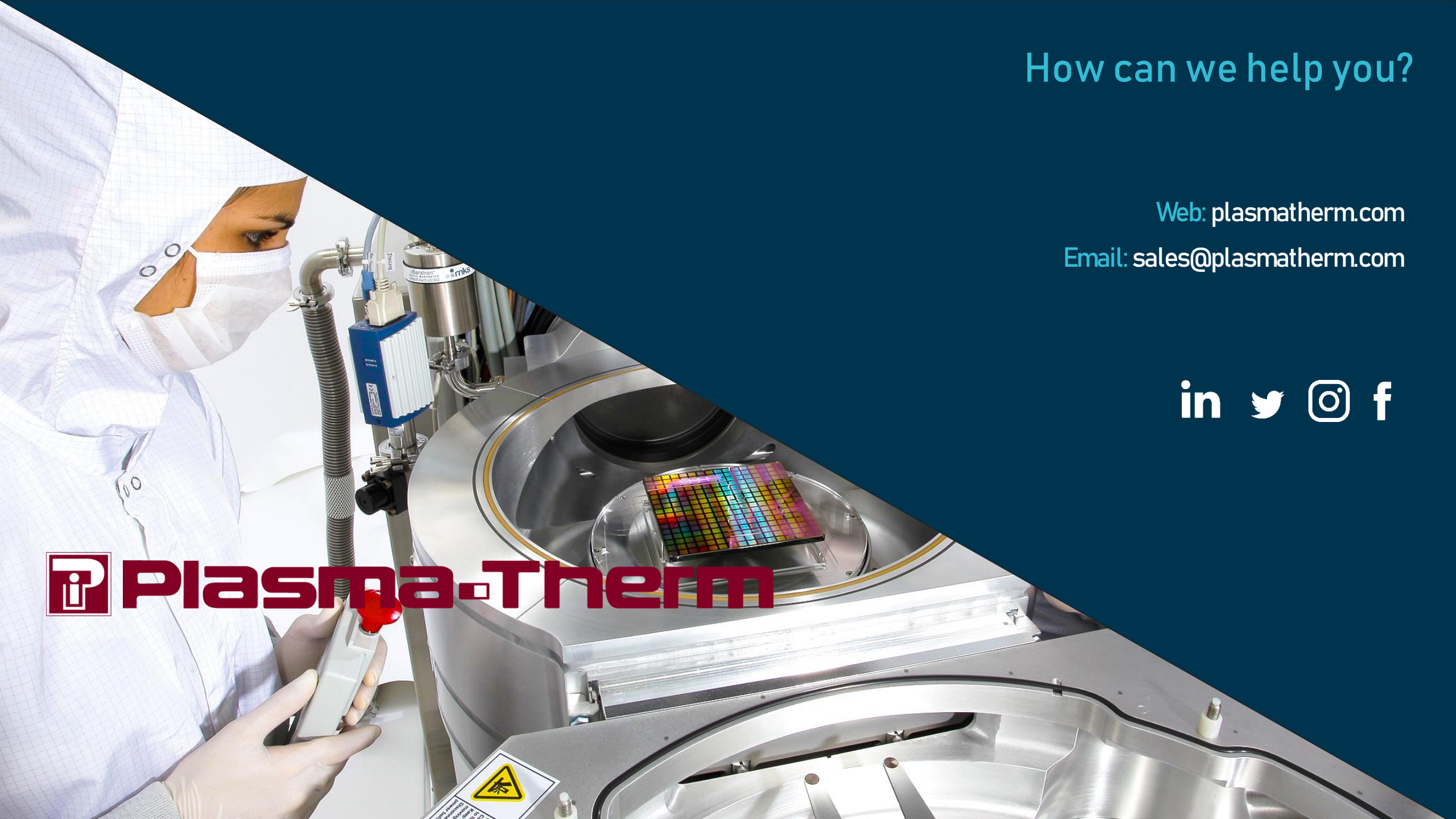
How can we help you?

Web: plasmatherm.com

Email: sales@plasmatherm.com



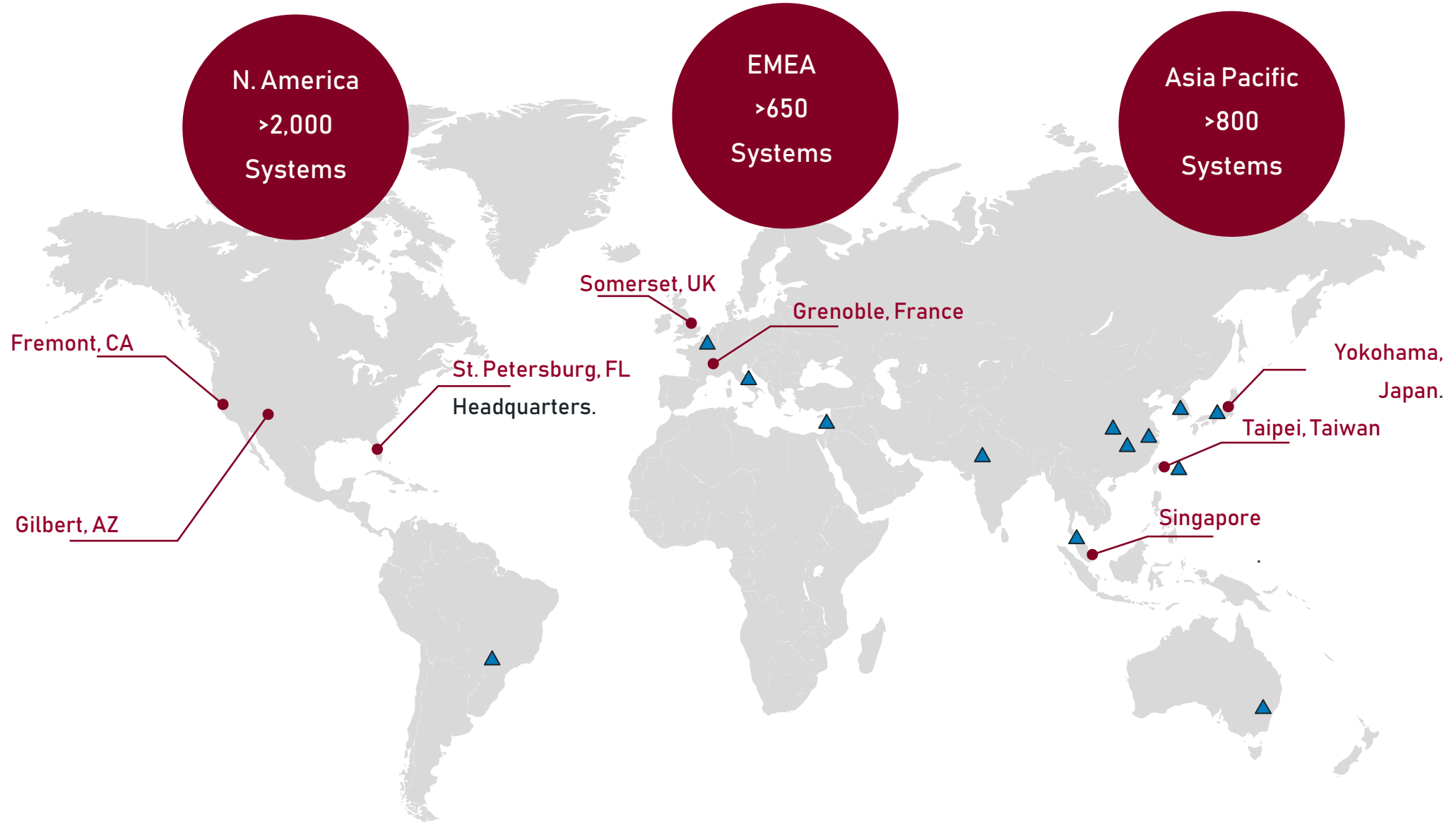
Plasma-Therm





Partnership – Excellence – Innovation

Worldwide Sales and Service



2022 TechInsights Awards



ETCH & CLEAN
EQUIPMENT



WFE TO SPECIALTY
CHIP MAKERS



SUPPLIERS OF FAB
EQUIPMENT



WFE TO SPECIALTY
CHIP MAKERS



FOCUSED SUPPLIERS OF
CHIP MAKING EQUIPMENT

11 Consecutive Years

RANKED 1st Etch & Clean Equipment
Supplier



Cassette to Cassette & Cluster Configuration Systems

Single Substrate and Load Lock Systems

Bench-top Single Substrate

Process Tools

VERSALINE, Singulator, QuaZar, Kobus, Endeavor, Eclipse, Heatpulse, Tegal, Odyssey, Mask Etcher

Process Tools

SHUTTLELINE, Takachi, Kayen

Process Tools

Vision
PlasmaPODS