Technology Transfer Brief

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A Proprietary Proton-Assisted Plasma Platform for Damage-Free and Sub-Micron Precision Etching in Next-Gen Electronics

Plasma & Device Laboratory

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A Proprietary Proton-Assisted Plasma Platform for Damage-Free and Sub-Micron Precision Etching in Next-Gen Electronics

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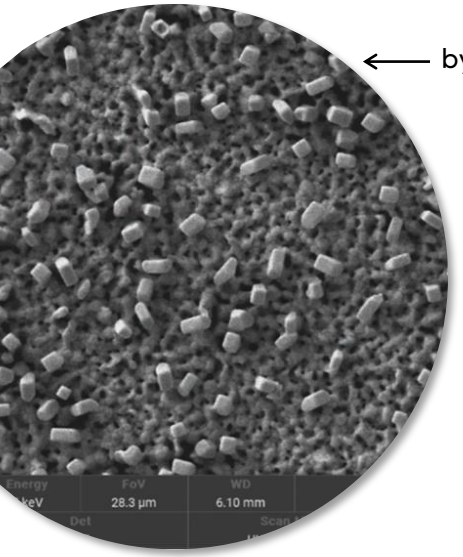
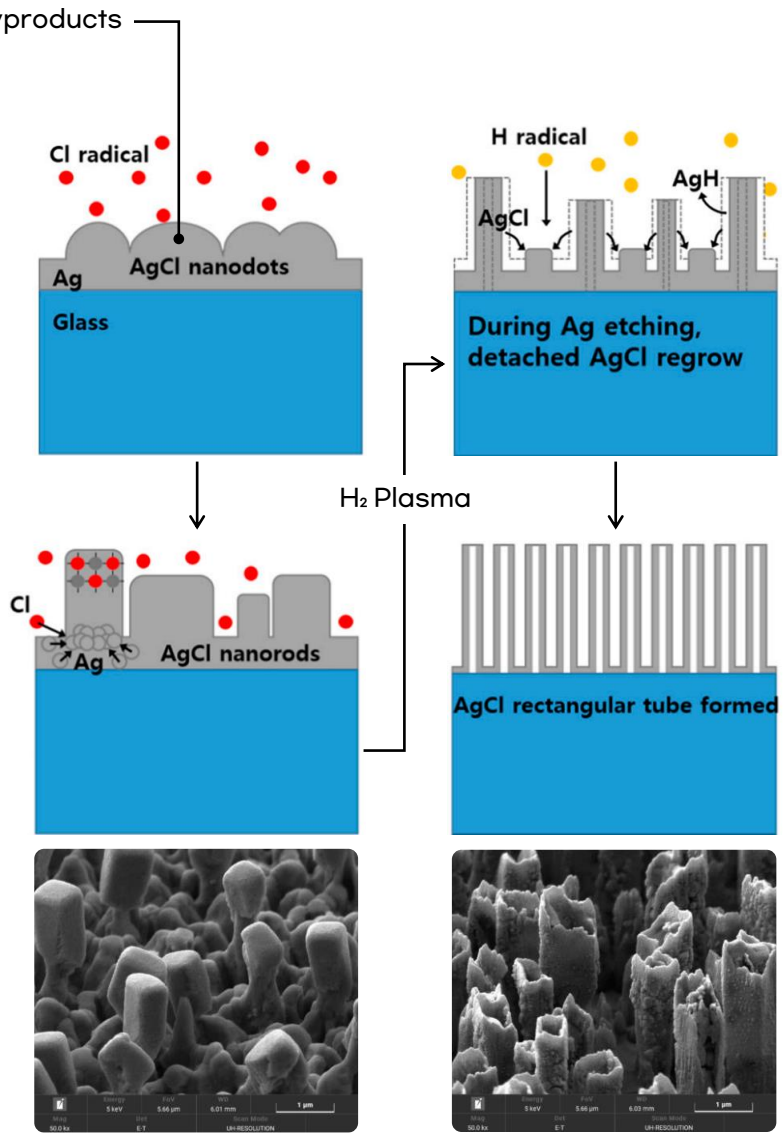
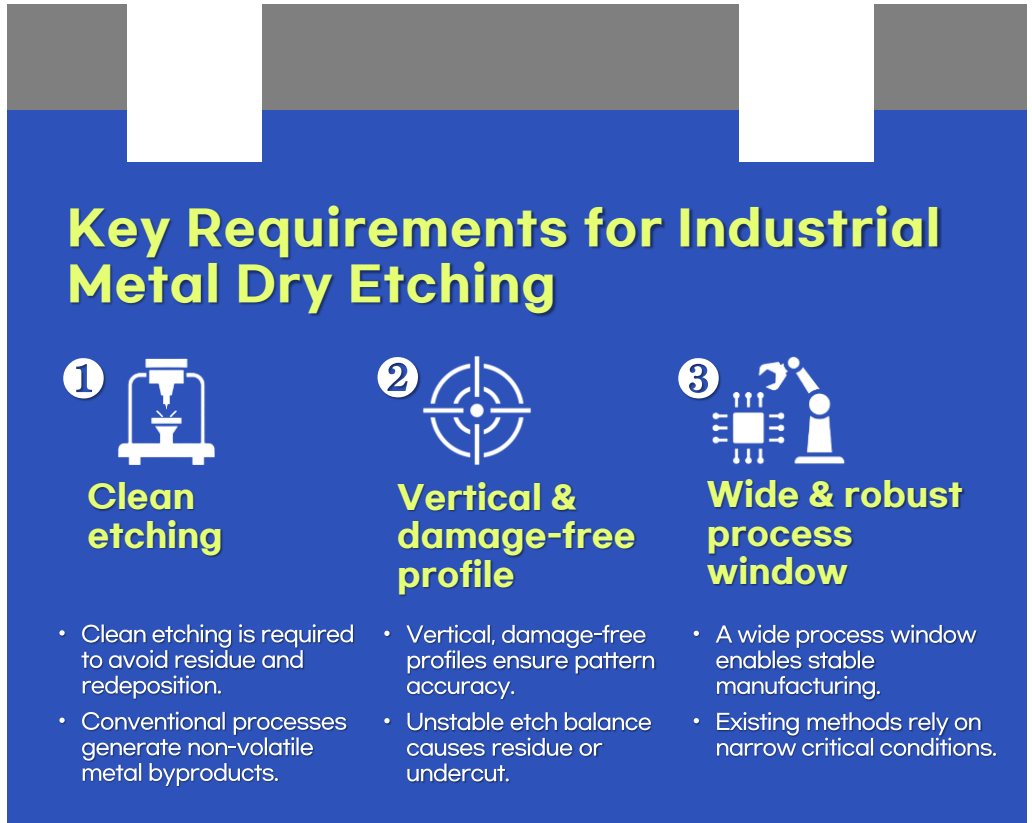
01 Chemical Origin of Metal Dry Etching Failure



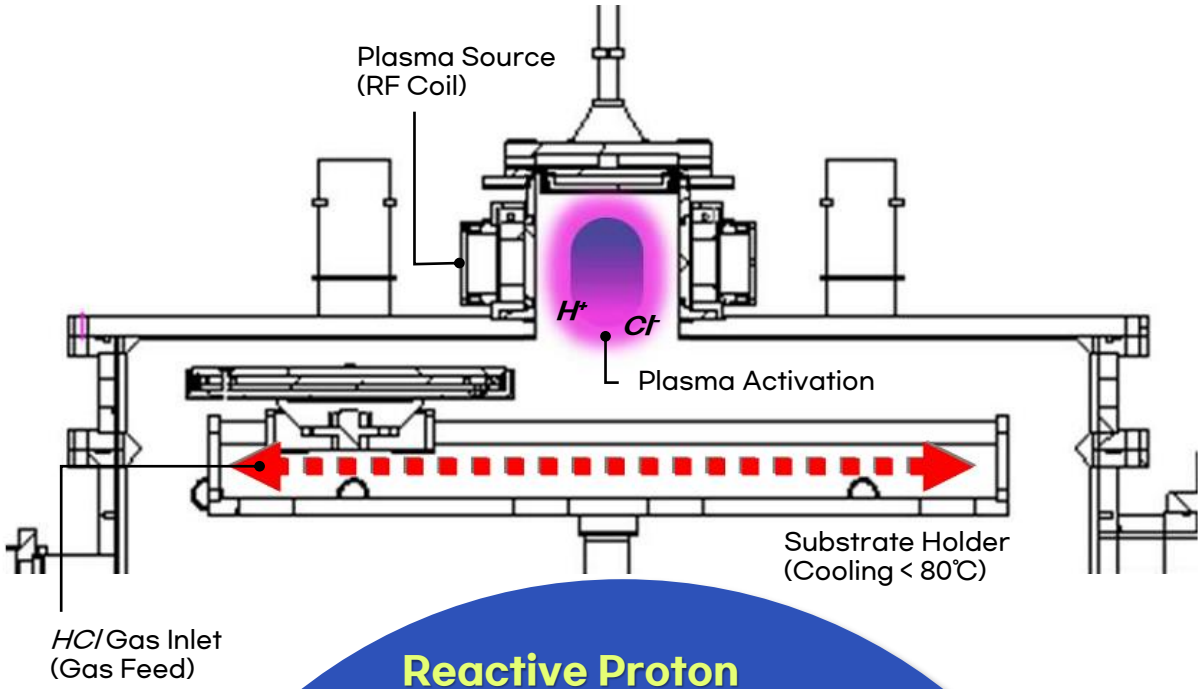


- In halogen-based plasma etching, metals react with halogens to form **non-volatile metal halides** (e.g., AgCl, $CuCl_2$).
- Under low-temperature and low-pressure conditions, these byproducts cannot volatilize and **instead redeposit** or **grow on the surface**, preventing clean etching.

- ✓ Non-volatile metal halides dominate over metal removal in halogen-based dry etching.
- ✓ Preventing metal halide formation is key to clean metal dry etching.



02 Technology Overview



Reactive Proton Assisted Etching (RPE)

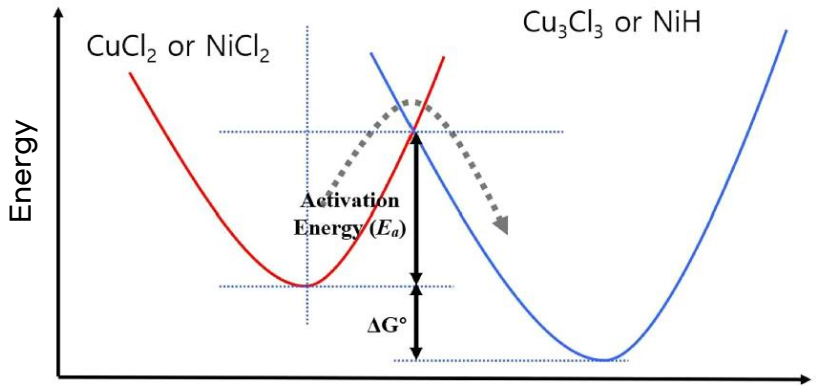
① Active Proton Supply

- Active Proton Supply : Generates high-density H^+ via dissociative ionization of HCl gas.
- High-electron-temperature ICP or ECR sources to maximize proton yield.

② Low-Temp Etching (Stability)

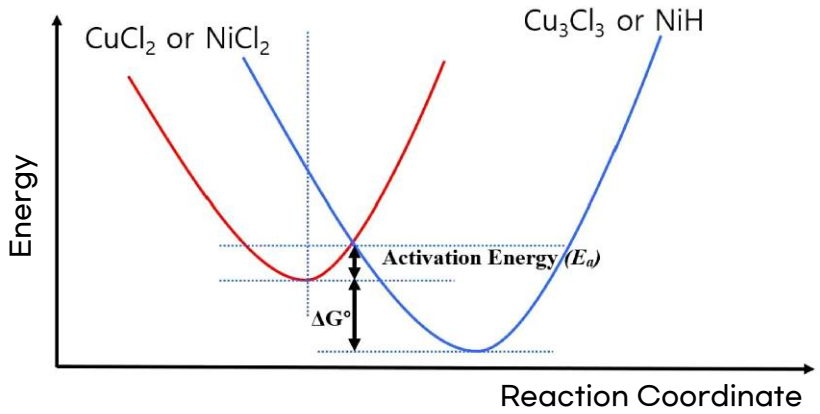
- Thermal Management : Maintains substrate <80℃ through Helium backside cooling.
- Chemical Conversion : H^+ assists in converting non-volatile by-products into volatile gases.

- ✓ **Clean Dry Etching** : Enables residue-free, vertical etching even at low temperatures (<50℃ in practice).
- ✓ Proton assistance **breaks the halide formation bottleneck** in metal dry etching.



Conventional Halogen Etching

- Halogen plasma forms non-volatile metal halides.
- Metal volatilization has a high activation barrier.
- Halide formation dominates metal removal.



Proton-Assisted Etching

- Reactive protons alter the metal reaction pathway.
- Protons lower the effective activation barrier.
- Metal removal becomes favorable.

03 Key Features & Advantages

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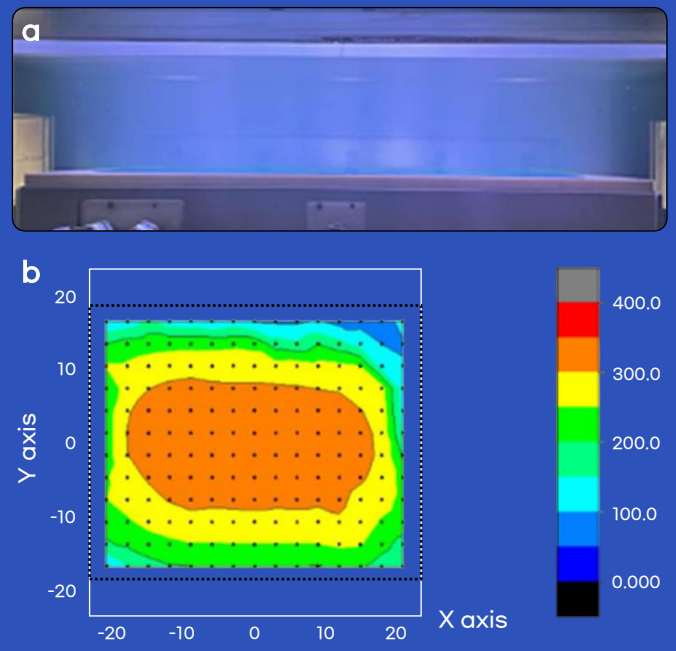
Large-area Scalability

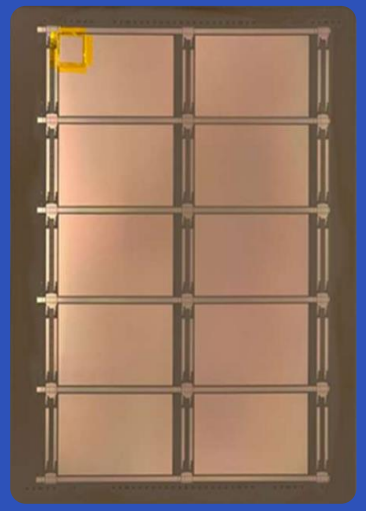
- **Performance** : ~10% uniformity on Gen 2 (370 x 470mm) substrates.
- **Mass-producibility** : Verified Gen 2 reproducibility; scalable to Gen 6 (1600mm).



Optimized plasma uniformity(a) and dry etching uniformity profile(b) via β-Equipment for Gen.2 glass process.

Cost & Time Efficiency

- **Performance** : Process temperature <50~80℃ with PR selectivity >5.
- ① Hard-mask step cost reduction, ② Prevents PR burning/hardening & substrate thermal damage.

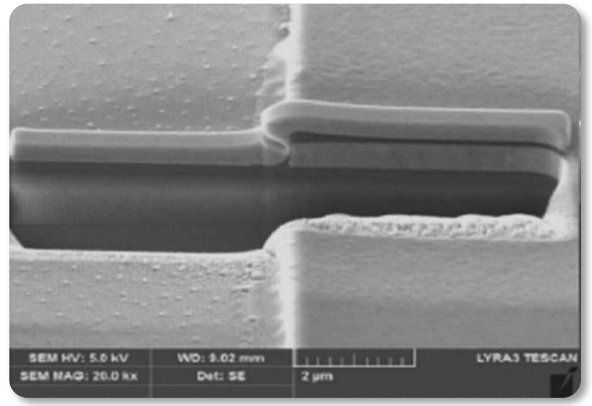


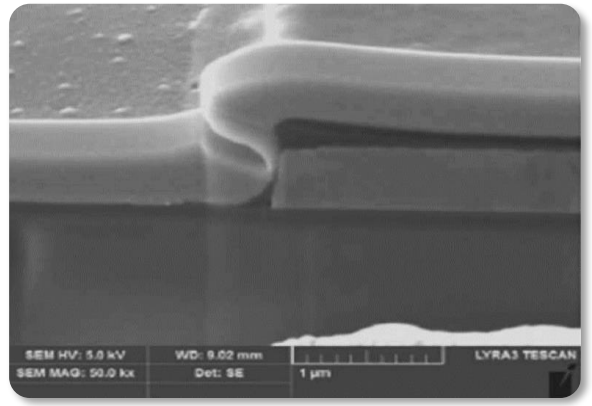
PR masked Cu thin film before dry etching.

PR masked Cu thin film after dry etching. (<50℃)

No PR burning or hardening due to ultra-low process temperature.

- ✓ **Sub-1㎛ fine patterning with zero residue.**
- ✓ **Advantages : Material Versatility, High Resolution.**





04 Strategic Business Opportunities

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- ✓ **Business Vision :** Proprietary proton-assisted plasma platform for damage-free, sub-micron precision etching.
- ✓ **Engagement Model :** IP licensing, collaborative R&D, and technical support for industrial scaling-up and retrofitting.

Collaborative development opportunities

❶ Core Hardware Design & Simulation

- Customized design of ReSLAN (Plasma Source) and Cooling ESC based on specific industrial requirements.
- Electromagnetic field/thermal simulation for process environment optimization.

❷ Customized Process Recipe Development

- Development of optimized etching recipes for diverse materials (Cu, Ag, NiTi, ITO, etc.).
- Support for achieving target etch rates, selectivity, and residue-free surfaces for new applications.

❸ Scaling-up & Retrofit Technical Support

- Technical advisory for scaling up from Gen 2 (370mm) to Gen 6 (1600mm) or larger production lines.
- Providing engineering solutions for retrofitting existing plasma systems with RPE modules.

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Collaborative R&D

IP license (Option/Exclusive)

Surface Processing Platform

Partners

- **Equipment OEMs** : Etch system manufacturers. (Retrofit & Upgrade kits)
- **Device Manufacturers** : Semiconductor foundries & display panel makers.

Proton-Assisted Surface Processing

Semiconductor (Logic/Memory)

- Low-temp Cu & multi-stack etching
- Higher yield & reduced RC delay

OLED Next-Gen Display

- Ultra-fine Cu/Ag patterning on organic PI
- High-res AR/VR & 30%+ cost saving

MEMS/NEMS

- Precision etching of functional alloys
- Sub-micron, damage-free structures

Intellectual Property

- Title : METHOD AND DEVICE FOR THIN FILM PROCESS INCLUDING ACTIVATED PROTON ASSIST PLASMA ETCHING
- Patent : US 19/210404, PCT-KR2023-018814, KR 10-2863236

CONTACT US

For inquiries regarding technology licensing, collaborative R&D, or partnership opportunities, please contact :

- Technology Transfer Agency : **IBU Inc.**
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Partnering to unlock new business opportunities through innovation.

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