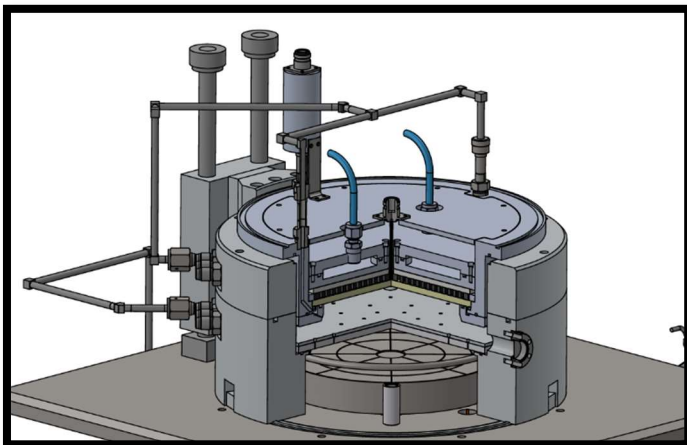


## **NLE-4000 - Hybrid PAALE/PEALD Systems**



**NLE-4000**



**NLE-4000 Cross Section with RF biasing for Shower Head with Planar ICP source**

### **Description**

- Patented Dual capability (PAALE/PEALD) in the same chamber without any mechanical reconfiguration.
- For the ALE process, only radicals from the planar ICP source are generated for adsorption ( Patented)
- Soft Ar etching is performed by applying RF to the shower head to remove the adsorbed radicals for ALE.
- Precise Atomic layer etching of 0.8Å to 1Å /cycle
- Removing native oxide with PAALE and depositing the passivating layer Si<sub>3</sub>N<sub>3</sub> with PEALD in the same chamber without exposing it to the atmosphere.
- Minimal chamber volume for fast cycle time and throughput
- Continuous ALD process for depositing passivating layer with less than 1Å uniformity
- Plasma contact with the substrate is eliminated with Nano-Master's patented ALD process.
- CE and SEMI standard

### **Features**

- 13" Ni-plated Al chamber with heated chamber walls
- NM-Planar ICP source with shower head gas distribution. Up to 8" substrate, heated upto 400°C ( Biasble) for ALE process.
- RF biasing for shower head – Soft ALE etching
- Onboard precursor glovebox for ALD cylinders
- Separate gas pod for toxic gasses with gas leak sensors for ALE gasses.
- Up to seven 50cc precursor cylinders
- 360 l/sec Heated maglev turbomolecular pump
- 2×10<sup>-6</sup> torr base pressure
- Fast pulse gas delivery valves
- Large area filter to capture unreacted precursors
- High aspect ratio structure coating
- LabVIEW user interface,
- Computer-controlled safety interlocks
- 26" x 44" footprint with enclosed panels ideal for clean rooms

### **Applications**

- 1) Precise etching of native oxide
- 2) Power Electronics
- 3) Etching 2D materials

**Before ALE etching**

**Avg Native oxide thickness:  
3.83nm  
n=1.38@632nm**

**After ALE etching**

**Etch Rate: 0.3Å/cycle  
Native oxide thickness:  
2.76nm  
n= 1.45@632nm**

**Process Parameters**

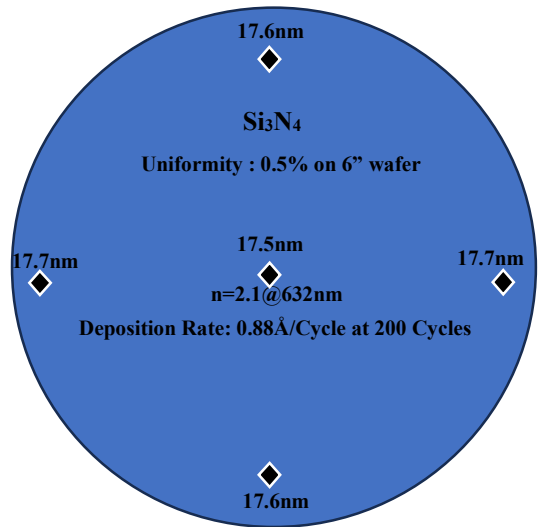
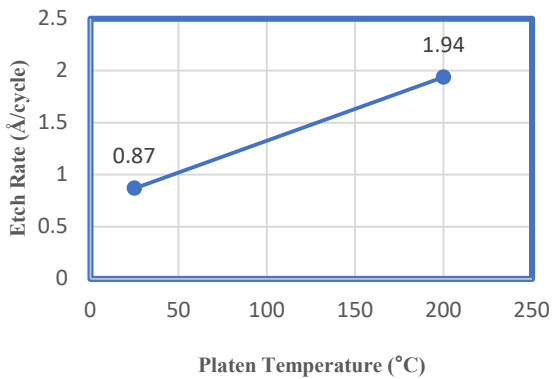
Step 1 : CF<sub>4</sub> and Ar with ICP plasma - 4s

Step 2 : Ar with showerhead plasma - 4s

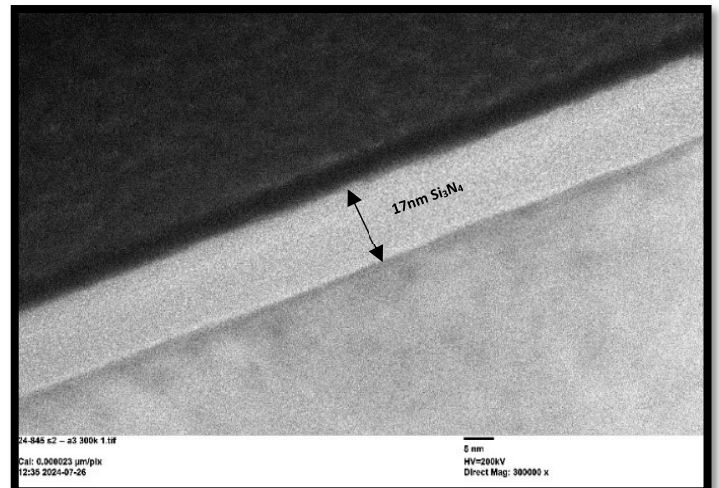
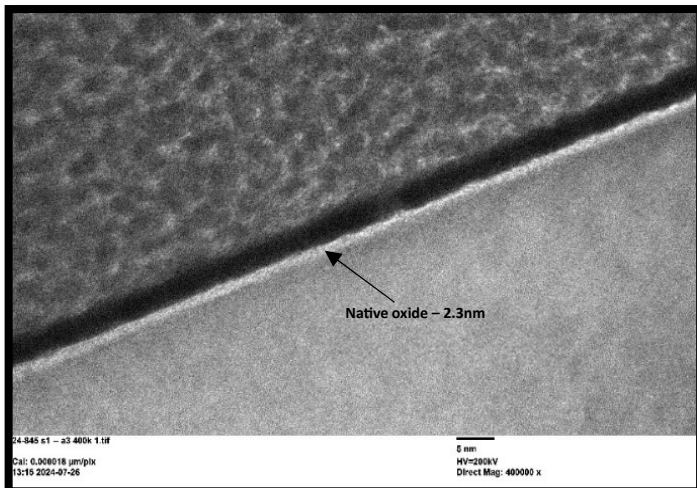
Cycle time: 8s

Pressure: 0.6 torr

**Effect of Platen temperature on PAALE etch rate**



**Deposition of Silicon nitride on 6" Si wafer by Continuous PEALD process**



**TEM image reveals removal of native oxide with ALE and ALD deposition of Si<sub>3</sub>N<sub>4</sub> in the same chamber.**