

# TEPHRA™

## 200 mm CLUSTER PLATFORM

TEPHRA is Forge Nano's single-wafer, thermal ALD cluster platform dedicated to the manufacturing of specialty semiconductor applications on 200 mm wafers and below. TEPHRA is powered by Forge Nano's ALD<sup>x</sup> technology which brings unprecedented throughput to a single-wafer ALD tool with no tradeoffs between speed, performance and yield. The conformality and quality achieved by TEPHRA offers solutions to the most challenging device architectures facing manufacturers in advanced 3D integration and More-than-Moore semiconductors.

## Key Features

### Hardware:

- Fast pneumatic valves (1 msec actuation)
- In situ pressure regime control capable of sub 1 sec cycle times
- Front-end cassette handling with load lock and robotic transfer module

### Process:

- Dedicated chambers for oxides, nitrides and elements
- Catalyzed thermal ALD processing eliminates need for plasma
- Up to 90% precursor utilization for selected processes

### Control:

- Modular PLC system
- SECS/GEM compliance with expanded data logging
- E95 compliant graphical HMI



### MATERIALS

**Oxides:** Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>, HfO<sub>2</sub>, ZrO<sub>2</sub>, Ta<sub>2</sub>O<sub>5</sub>, AZO, TiO<sub>2</sub>, Y<sub>2</sub>O<sub>3</sub>

**Nitrides:** TiN, TaN, AlN, GaN, ZrN,

**Elements:** Ru, Pt, Co, Cu, Ni

### APPLICATIONS

Barrier Films  
Seed Layers  
Moisture Barriers  
Dielectrics  
Passivation Layers  
Transparent Conductive Oxides

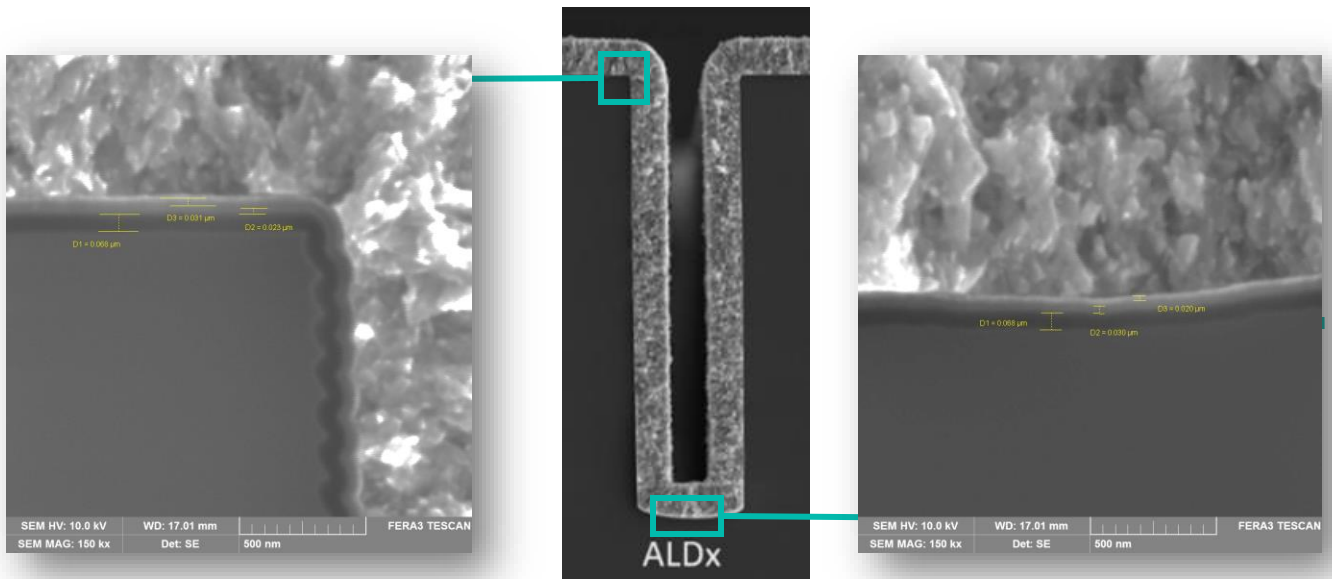
## SPECIFICATIONS

TEPHRA is available in 3 configurations: a 4-sided, 6-sided and 8-sided cluster platform.

Specification	3 Process Modules	4 Process Modules	6 Process Modules
Wafer Sizes	Up to 200 mm		
Process Temperatures	80°C to 300°C		
Precursor Channels	Up to 6		
Power Requirements	3-Phase,4-Wire 208Y/120 V @ 60Hz 3-Phase,4-Wire 400Y/230 V @ 50Hz		
Certifications	SEMI S-2, SEMI S-8, CE		
Main dimensions (LxWxH)	2660x3745x1960 mm	2685x3840x1960 mm	4070x3130x1960 mm
Ancillary Equipment	Main Power Distribution 300x900x1800 mm Transport Module Dry Pump 450x230x275 mm Process Module Dry Pumps 750x280x430 mm		

## CASE STUDY METAL BARRIER SEED STACKS

TEPHRA enables conformal depositions of nitride and metal films in high aspect ratio structures. High quality metal barrier seed stacks will allow device manufacturers to scale through silicon and through glass vias to aspect ratios greater than 10:1. Below shows an SiO<sub>2</sub>/TiN/Ru stack deposited in a 4:1 trench using thermal-only ALD. Validation in 25:1 AR trenches is ongoing with industry partners.



**ALD<sup>x</sup> Trilayer stack –  
Sidewall**

**ALD<sup>x</sup> Trilayer stack –  
Bottom of Trench**