ATONARP ASTON™

Maximizing Throughput in Low-K Dielectric Deposition

Application Brief

Introduction

Deposition wafer throughput is a key metric of FAB efficiency and an area where constant improvement leads to lower cost per move and reduced Capex expenditure. Aston has been successfully deployed in low-K dielectric deposition applications (specifically silicon nitride Si_3N_4) where it has achieved throughput time reduction while reducing particulate contamination.

The Problem

Low-K dielectric deposition requires frequent process chamber cleans to remove the build-up of deposition condensates. Failure to remove the condensates may results in particle flakes delaminating from the chamber walls causing yield loss. Cleans are typically performed every 5 wafers (5 times during a 25-wafer lot).

The Solution

Chamber Clean End Point Detection

Minimizing the chamber clean cycle time, using end point detection, is required to maximize the overall process throughput. However, legacy metrology solutions using residual gas analyzers (RGAs) or optical emission spectroscopy (OES) are ineffective. Nitrogen trifluoride (NF_3) gas used for chamber cleaning is highly corrosive to RGA electron impact ionization sources (rendering them impractical for production) and OES requires a plasma which is not present during the cleaning cycle. Historically the chamber clean cycle has been a fixed time process step with sufficient margin built in to ensure chamber-to-chamber statistical variations are accounted for. With Aston, precision end-point detection-based chamber clean results both in faster processing time without compromising process margins, as well as avoiding over-cleaning that can create Aluminum Fluoride contamination and require extensive chamber seasoning.

Aston Demonstrated Results

>40% Reduction in Process Time

In a recent on-tool, in-FAB production study, Aston reduced the overall chamber clean cycle by up to 80%. This resulted in >40% reduction in total wafer deposition plus chamber clean cycle time for 5-wafer process cycle.

Higher Throughput & Yields

In addition to the process time reduction, it was also observed that the Aston end point-based clean cycle resulted in few particles being caused by chamber side wall over etch seen from over cleaning in the time-based legacy solution. Overall product yield improvement is predicted based on the lower post processing particulate contamination seen.

Aston Benefits

- Corrosive Gas Resistant
- Condensate Resistant
- Real Time, Actionable Data
- Cloud Connectivity Ready
- No Plasma Required
- Best-in-Class Features
  - Stability
  - Repeatability
  - Sensor Lifetime
  - Mass Range
  - Resolution
  - Min Detectable Partial Pressure
  - Sensitivity (ppb)
  - Sample Rate

Applications Supported

- Dielectric Etch
- Metal Etch EPD
- CVD Monitoring and EPD
- Chamber Clean EPD
- Chamber Fingerprinting
- Chamber Matching
- High Aspect Ratio Etch
- Small Open Area <0.3% Etch
- ALD
- ALE

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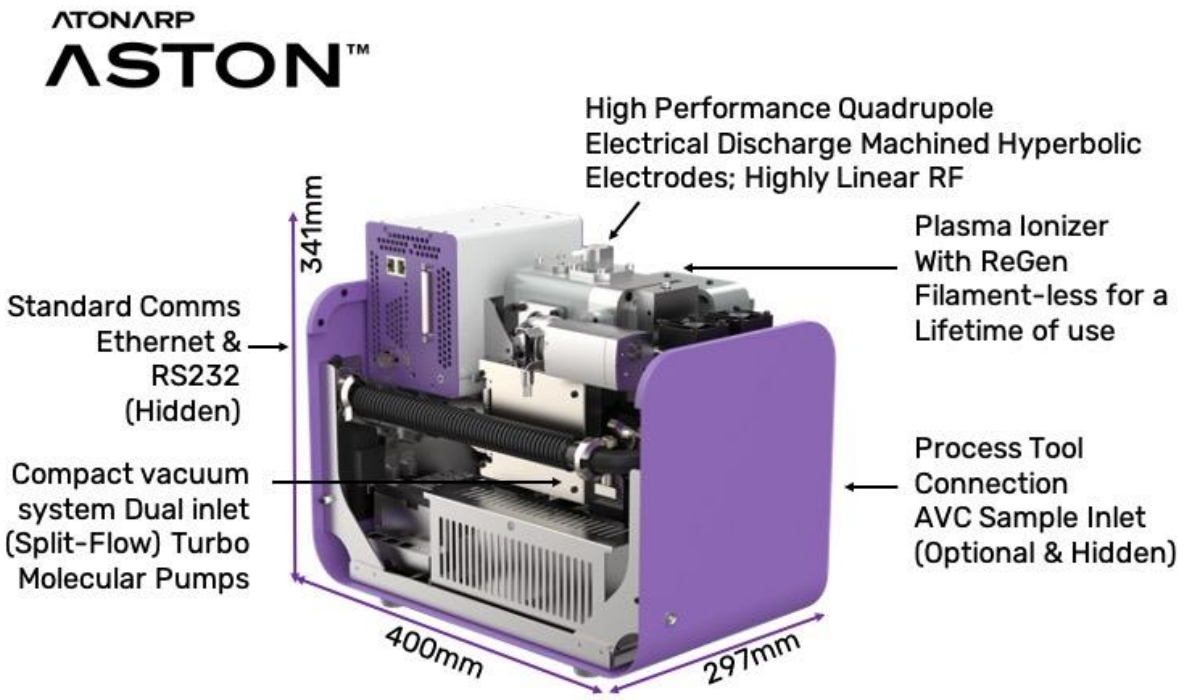

Equipment and Process Co-Optimization (EPCO): A $38B Long-Term Manufacturing Optimization Opportunity

Many advanced manufacturing processes now require Equipment and Process Co-Optimization (EPCO). A 2021 paper by McKinsey & Co. demonstrated that semiconductor manufacturing optimization, using artificial intelligence (AI) & machine learning (ML), represents a $38B cost saving opportunity through improved yields and increased throughput. McKinsey highlighted the single biggest intervention point to help companies realize these benefits is adjustment of tool parameters, using live tool sensor data from current and previous steps to enable AI/ML algorithms to optimize the nonlinear relationship between process operations. Key to successful AI/ML deployment is actionable real-time data. Aston in-situ real-time molecular diagnostics and its cloud connected data are key technologies enabling this capability to unlock the potential for semiconductor EPCO.

Atonarp is advancing medical diagnostics, life sciences research, and industrial process control through next-generation digital molecular profiling. In-situ molecular profiling in advanced manufacturing means higher throughput, improved efficiency, and reduced waste. Real-time, quantitative diagnostic tests can improve outcomes and patient satisfaction at lower cost.