

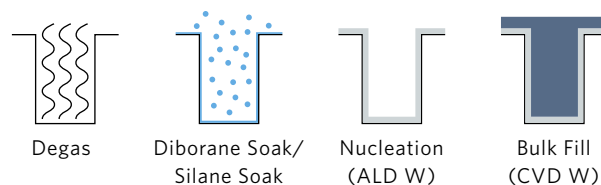
APPLIED CENTURA[®] iSPRINT[™] TUNGSTEN ALD/CVD

UNIQUE INTEGRATED ALD/CVD TUNGSTEN SYSTEM
FOR $\leq 65/70\text{nm}$



The Centura iSprint Tungsten ALD/CVD (Atomic Layer Deposition/Chemical Vapor Deposition) system provides complete contact/via fill for high-aspect ratio structures and extends the capability of tungsten technology to 45nm/55nm for Logic and Memory applications. This production-proven system provides low contact resistance (R_c) and tight R_c distribution to enable high aspect ratio W contact in advanced devices. The ALD process reduces the nucleation thickness from typical CVD values of 300Å to as thin as 12Å, while maintaining excellent barrier performance for reliable, repeatable integration performance with a wide variety of liner/barrier materials, including PVD (Physical Vapor Deposition) Ti/MOCVD (Metal Organic Chemical Vapor Deposition) TiN, and SIP[™] (Self-Ionized Plasma) TTN. By delivering 100% conformal coverage, the iSprint ALD chamber enables 50% reduction in core size and >65% reduction in core density, post-W CMP (Chemical Mechanical Planarization). The dedicated Sprint[™] W CVD chamber leverages the production-proven 300Torr H_2 reduction of WF_6 process to provide excellent W bulk fill.

iSPRINT PROCESS SEQUENCE



iSPRINT ROADMAP (Logic/Memory)

90nm	65nm/70nm	45nm/55nm
Sprint W CVD	Sprint W CVD iSprint W ALD/CVD	Sprint W CVD iSprint W ALD/CVD

FEATURES

- Advanced W CVD chamber design utilizing ceramic heater and remote plasma clean
- Innovative ALD chamber design with rapid gas delivery system
- Non-contact shadow ring minimizes W deposition on the edge and bevel
- Excellent wafer handling for precise, repeatable wafer placement during deposition
- Robust ALD/CVD integration on production-proven Centura platform

BENEFITS

- 100% conformal nucleation step coverage with ultra-thin ALD film (<12Å) enables 50% reduction in core size and >65% reduction in core density
- Superior, consistent edge exclusion control
- Low contact resistance and R_c distribution
- Reliable, repeatable integration performance with ultra-thin MOCVD TiN liner and other liner/barrier processes for contact gap fill

UNIQUE SYSTEM AND PROCESS INTEGRATION

The innovative iSprint ALD chamber delivers B_2H_6 - and SiH_4 -based films to meet both Logic and Memory extendibility requirements. The ALD W nucleation layer provides superior integration performance with as-deposited MOCVD TiN, eliminating the need for either furnace or RTP (Rapid Thermal Process) anneal of the MOCVD TiN film.

The amorphous nature of the nucleation layer and low fluorine content ($<1E18$ at/cm²) produce excellent barrier properties. For Memory applications, the iSprint ALD chamber extends SiH_4 -based nucleation with a smooth, high-reflectivity film (matching conventional CVD) and proven integration with SIP TTN and other liner/barrier processes. SiH_4 -based ALD W deposits nucleation layers as thin as 50Å.

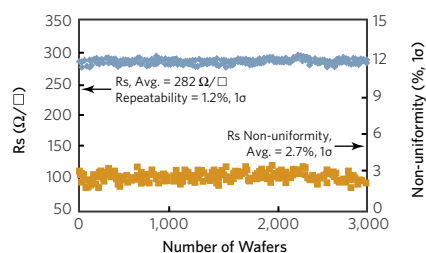
The Centura iSprint Tungsten ALD/CVD system delivers superior edge exclusion control that is consistent from wafer to wafer, eliminating edge peeling issues that can lead to particle generation. With two chambers used for the deposition sequence, the system minimizes the risk of wafer movement by requiring only one wafer move from the deposition process start (preheat/soak) to finish (bulk W deposition). Precise wafer placement in the chamber is also ensured with the Local Center Finder (LCF) which delivers accurate non-contact centering ability that is repeatable from wafer to wafer. In addition, the ALD/CVD chamber designs incorporate the non-contact shadow ring which minimizes W deposition on the edge and bevel.

The ALD chamber design combines a proprietary rapid gas delivery system and small chamber volume to enable fast, effective gas purging (ALD cycles as low as 0.10 seconds) with low gas flows, resulting in high throughput and low cost of consumables. Both ALD and CVD chambers incorporate a ceramic heater and remote NF_3 plasma clean to deliver low mechanical defect levels. These advanced technologies are integrated on the production-proven Centura platform.

iSPRINT DEMONSTRATED PERFORMANCE

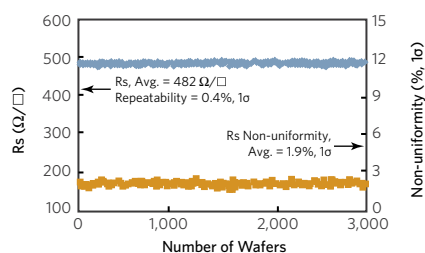
ALD W Process

Rs Repeatability

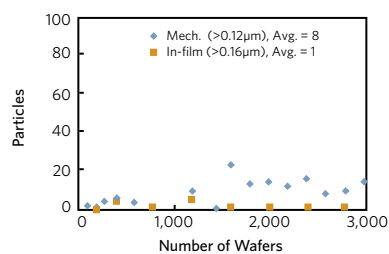


ALD/CVD W Stack Process

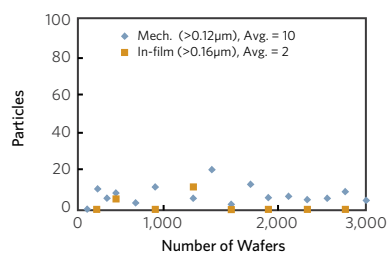
Rs Repeatability



Particle Performance



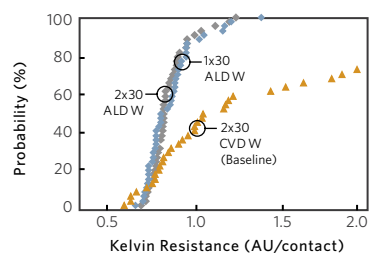
Particle Performance



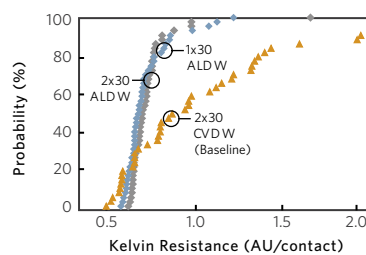
Stable, repeatable performance with low mechanical and in-film particles

INTEGRATION PERFORMANCE

Contact on Active (n+)



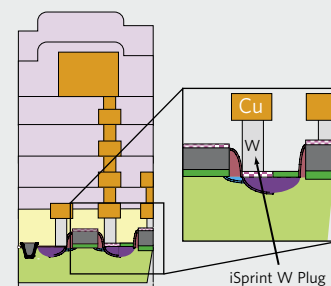
Contact on Active (p+)



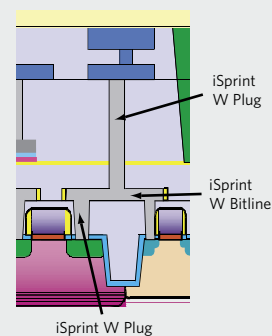
Robust integration performance of ultra-thin TiN with iSprint Tungsten ALD/CVD

iSPRINT APPLICATIONS

Logic



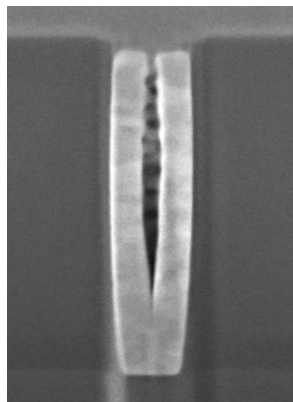
Memory



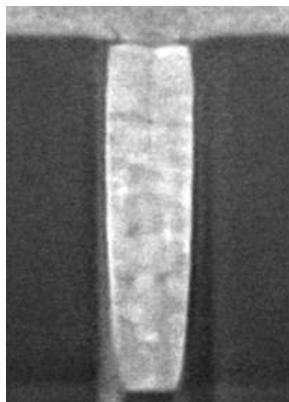
iSPRINT STEP COVERAGE AND FILL

140nm, 5:1 A/R

Conventional W CVD

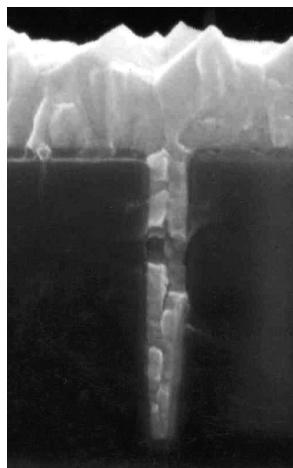


iSprint W ALD/CVD



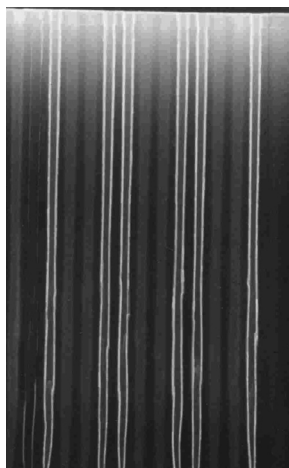
100% conformal nucleation step coverage by ALD W enables significant reduction in core size and density after W CMP

50nm, 8:1 A/R

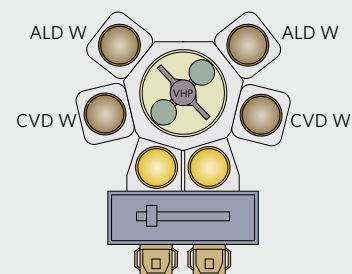


Complete contact fill for <65nm technology node

200nm, 50:1 A/R



100% ALD nucleation step coverage

BKM CONFIGURATION300mm Centura iSprint
Tungsten ALD/CVD

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