THE SKY'S THE LIMIT WITH CLUSTERLINE® 300

As we strive for increased performance and functionality of chips, back-end-of-line (BEOL) of the front-end is starting to converge with advanced packaging. Evatec's **Kai Wenz**, Senior Manager Development Projects for BU Semiconductor explains the thinking behind the release of a new front-end sputtering module on the latest variant of CLUSTERLINE® 300. Together with new platform pre-treatment features through different degassing and clean etch options, the source features include hot electrostatic clamping with active backside gas conduction heating up to 450°C, advanced power modulation and new shield design to meet particle and contamination requirements of CMOS front-end technology.

Platform

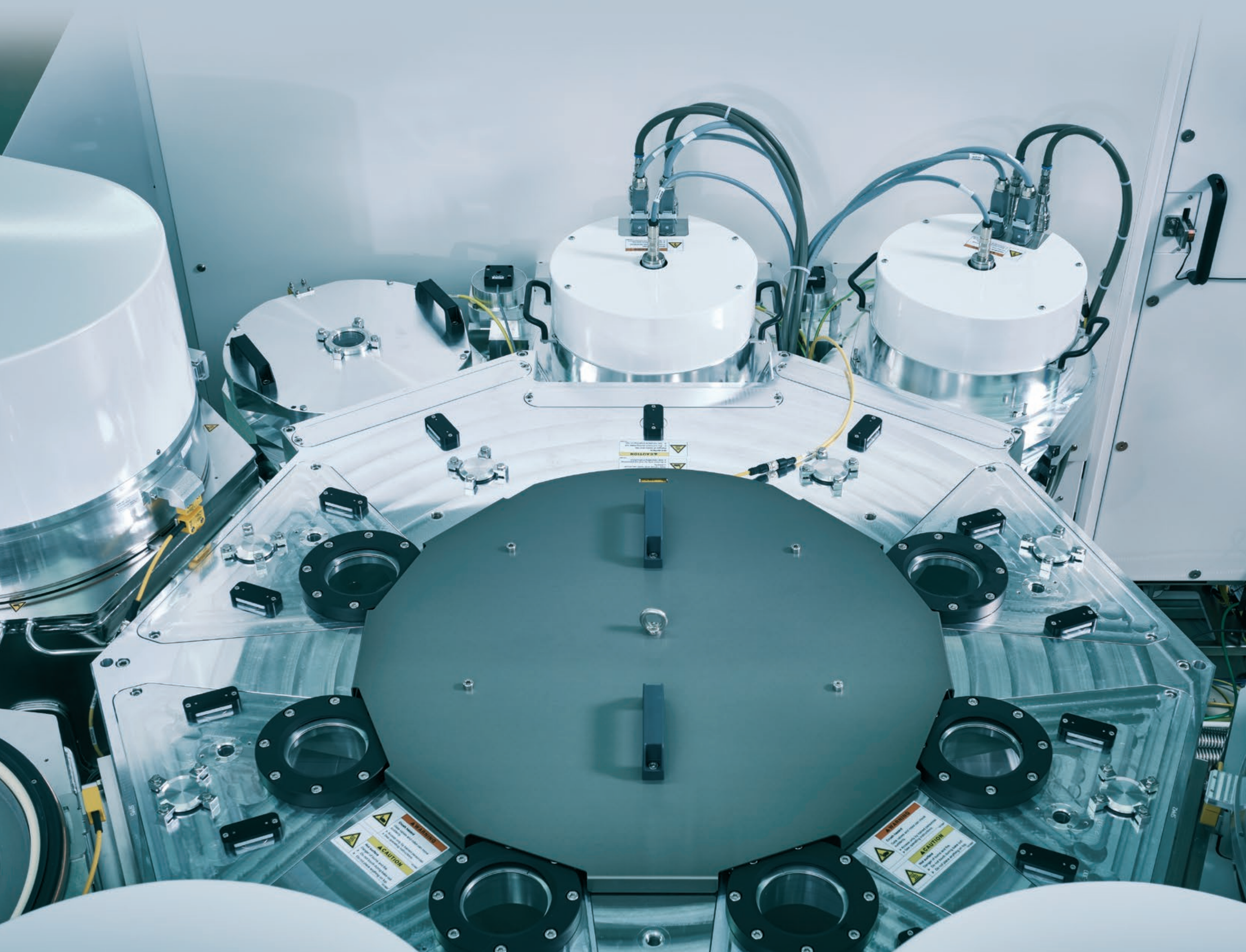
Starting with our standard high volume production CLUSTERLINE® 300 platform including existing auxiliary modules like lamp degassers and cooling plates as a baseline, we have enhanced performance by hardware design changes to achieve low metallic contamination and low particle performance. These are basic key requirements for frontside devices as structures get smaller and smaller and more sensitive. Such changes have enabled metallic contamination levels less than 1E+10 at/cm² and mechanical particles for size >60nm less than 15 adders (see table 1). Knowing the sensitivity of the interfaces between each process step under vacuum we have also equipped the vacuum transfer system with an additional cryogenic unit to achieve a lower base pressure <6.0E-8 mbar and increase the purity of the vacuum.

The atmospheric front-end of the CLUSTERLINE® 300 is equipped with a FOUP loading system capable for up to 3 FOUPs, aligner stations, buffer / dummy wafer and flipper stations based on customer needs. The aligner station is an Evatec customized unit that allows multiple wafer orientation including glass substrates.

For process pre-treatment prior to deposition we can offer our customers lamp degassers to rapidly heat up and outgas wafers up to 350°C wafer temperature and prepare it for the next process step. After processing we have the option to cool down substrates from process to room temperature before returning to the FOUP.

PVE soft-etch single wafer process module

Beside the adaptations to comply with contamination requirements we have enhanced the process shield set for tight "within wafer" uniformity performance <2.5% (max,min) for wafer cleaning and removal of oxides on the substrates. This ICP etch module has the capabilities to etch metal layers and is generally not sensitive for over etching of substrates since its equipped with a metal cage which also improves the kit life. As an option, the ICP soft-etch chamber can also be used for Ar/H2 etch process based on customer requirements in addition to conventional pure Ar etch.



Item	Ti-PVD	TiN-PVD	AlCu-PVD
Typical thickness range	100 – 120nm	100 – 200nm	100 – 5000nm
Deposition rate	3.23nm/s	1.49nm/s	9.8 - 22.6nm/s
WiW thickness uniformity (max, min)	1.30%	2.50%	2.10%
WiW RS uniformity (max, min)	1.90%	3.90%	1.90%
WtW thickness / RS uniformity (max, min)	0.30%	0.60%	0.50%
Specific resistivity	58 μΩ*cm	137 μΩ*cm	2.9 μΩ*cm
Mech. particles >0.06um	4 adders	7 adders	3 adders
>0.12um	0 adders	1 adders	9 adders
>0.96um	0 adders	0 adders	0 adders
In-film particles >0.2um*	14 adders	21 adders	23 adders

** without TWAS coated shields*

PVD single wafer process module

Process modules have also been enhanced with new process shield kits with the focus on variable large range target-substrate distance capabilities, low particles and contamination, uniform gas distribution and low particle performance.

From the source side we can now offer the next generation of PVD sputter source ARQ 320 which is capable / prepared for DC, DC pulsed, RF and HIPIMS sputtering. This new sputter source allows circumference non-uniformity by advanced power modulation and radial compensation by magnet lift design.

The flexible module setup can be equipped with active Electrostatic Chuck (ESC) hot (450°C) and cold, or alternatively with clampless, passive chuck depending on the configuration and process requirements including RF chuck bias.

With these hardware features we can achieve within wafer uniformity performance <3.0% (max,min) depending on the sputter materials for physical film thickness and sheet resistance.

Customized process modules

The markets addressed by Evatec today span from discrete power devices and mixed signal power IC applications up to CMOS interconnect technology, but platform performance and flexibility open up even further opportunities with other modular options. For example, the "Multi-source" option in a single chamber allows installation of up to 4 small size targets for reduced time to market development of new materials, or co-sputtering of different materials including rotating chuck. Integration of a batch sputtering module which we typically use for optical or magnetic laminate coatings, or advanced directional sputtering with high ionized sputtering technology in combination with increased target substrate distances and biased chuck also bring even more capabilities and flexibility for the overall platform.

The sky's the limit

The new front-end module is positioned at the high end on the performance level but from a flexibility perspective the module and platform concept will meet all types of upcoming front-end integration applications. Our customers will be able to bridge the gap enjoying CMOS compatible sputtering equipment and the flexibility for heterogenous integration of RF-devices, optical or magnetic sensors or any 3D-IC application.

"With all these features Evatec enables new possibilities for our customers. We might be starting off with power applications, but we really aren't facing any limits in the future!"