

ECL – Supporting customers with small scale production & thin film characterization services

Head of Evatec Competence Laboratory *Philip Zeller* gives us an update on the latest capabilities in the ECL and how we are now expanding the services available to customers helping them not only with technology development and prototyping, but also small scale production and quality control in their daily business.

ECL – Ready to support customers in deposition and characterization

Evatec's ECL was established back in 2019 as a center for collaboration with technology partners and customers. It brought equipment and people together in an environment optimized for the best sample production, networking, information exchange and creative thinking. For the last 5 years, it has been a place where customers from around the world joined Evatec process engineers working together on the development and optimization of their next generation thin film processes.

And now it's time to make capabilities of ECL available to customers needing to characterize films deposited within their own facility where they don't have the metrology tools, or needing small scale production support, e.g. as an interim solution whilst they are busy ramping up their own production facilities.

ECL – A lab like a fab

The ECL is an easy place to work- housing both deposition tools and measurement equipment within a central measurement laboratory (EML).

At the heart of the ECL lies a portfolio of thin film tools with advanced control capabilities in a range of configurations to support applications across advanced packaging, power, wireless, MEMS, optoelectronics and photonics. System architectures are available to handle substrate sizes up to 650mm x 650mm.

Table 1 summarizes the range of tool architecture and typical processes available within the fab.

Tool architecture types	Process technologies	Substrate handling / loading	Processes	APC capabilities
<ul style="list-style-type: none"> ▪ Batch ▪ Cluster ▪ Inline 	<ul style="list-style-type: none"> ▪ Etch ▪ PECVD ▪ PEALD ▪ Sputter ▪ Evaporation 	<ul style="list-style-type: none"> ▪ Manual ▪ Cassette-to-cassette ▪ AFEM ▪ Single wafer processing ▪ Batch processing 	<ul style="list-style-type: none"> ▪ Dielectrics ▪ TCOs ▪ Metals ▪ Piezoelectrics ▪ Soft magnetics 	<ul style="list-style-type: none"> ▪ Plasma Emission Monitoring (PEM) ▪ Broadband Optical Monitoring (GSM)

Table 1: Summary of ECL capabilities

How can we help you?

New process development and test



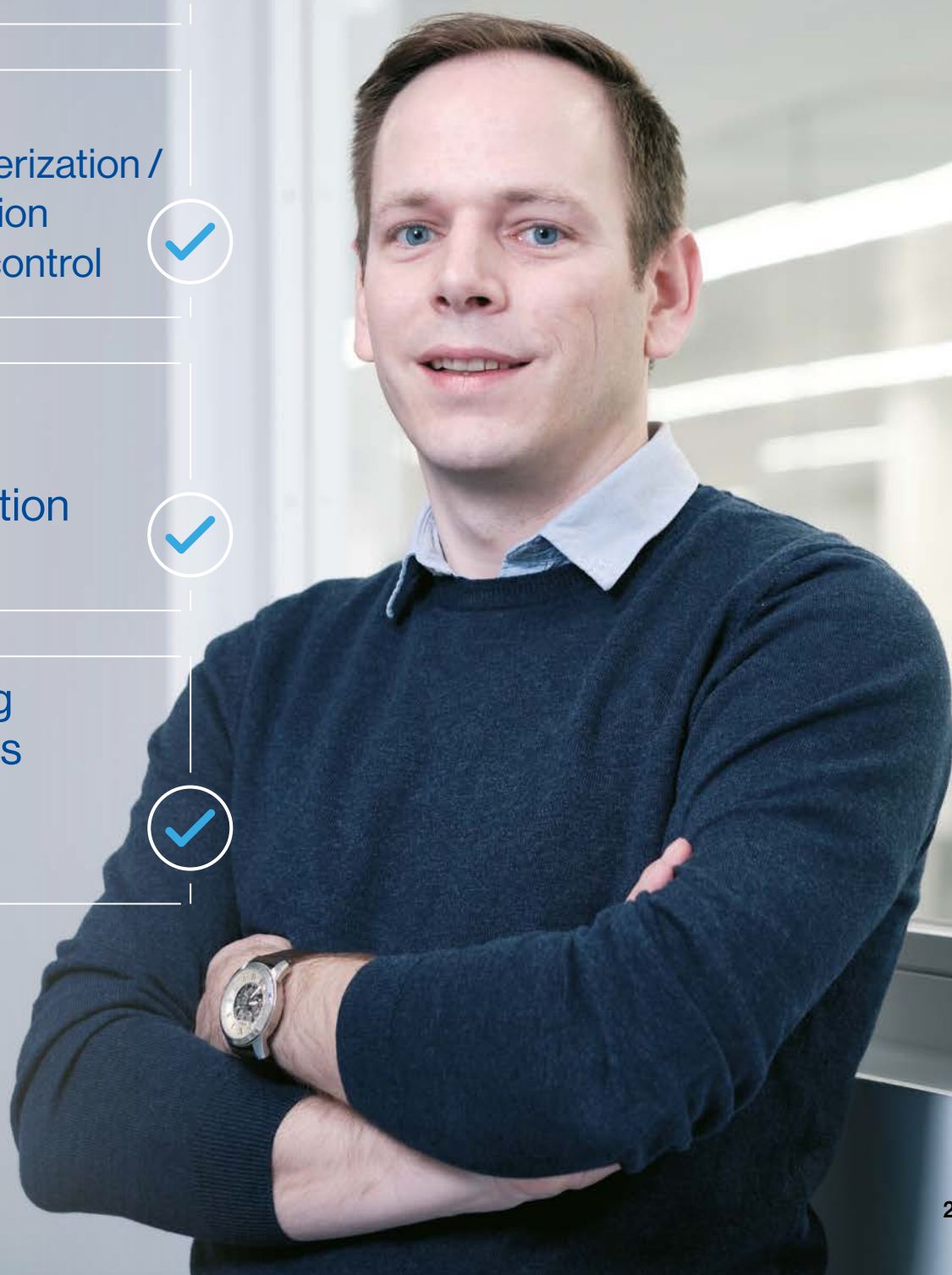
Film characterization / production quality control



Small scale production



Training services





Thin film characterization and quality control

The EML is a hub for metrology experts.

Equipped with tools ranging from basic mechanical profilometers to advanced instruments like AFM, SEM, XRD and XRF, the EML has constantly enhanced its capabilities for advanced characterization of the deposited thin films.

The AFM provides detailed surface topography information with sub-nanometer resolution.

XRD offers insights into crystalline grains within a film, enabling the determination of crystal structure, lattice distance, grain width, crystal quality, and orientation. Additionally, we can measure instrument pole figures and reciprocal space maps for more sophisticated film structure analysis.

X-Ray Reflectometry allows us to measure film thicknesses (typically from a few up to 150nm) and roughness, including multilayer systems and their buried interface roughness.

XRF enables precise, non-destructive film thickness measurements in the sub-nanometer range and provides information about the elemental composition of a sample.

The latest addition to the metrology lab is the Zeiss FIB-SEM. This tool allows us to capture images with information on the topography and the composition of a sample. In combination with its Focused-Ion-Beam (FIB) it allows us to capture images of structures such as trenches and vias and analyze the conformity of the deposited films. Figure 1 illustrates a typical case study.

The EML and its measurement tools are all conveniently located at the heart of the ECL.

The full range of metrology techniques available to customers is illustrated in Table 2.

The ECL – A perfect production environment

Needless to say, the ECL is the perfect production environment of 3000 square meters with a range of clean room spaces down to ISO 4 and particle levels are measured online to maintain a consistent environment. Highly experienced Evatec staff operating the deposition equipment and making thin film characterization measurements on behalf of customers have access to the expertise of Evatec's application and process engineers.

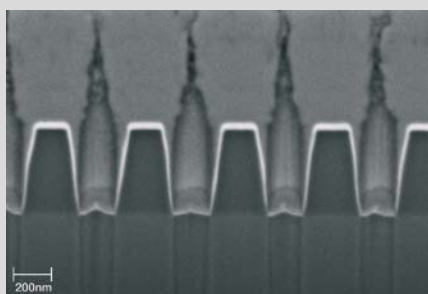


Figure 1: Case Study – Analysis of 3D structures

We observe silicon blind vias covered by a tantalum layer, which appears as the brightest element in the picture. This tantalum layer was deposited using our advanced long-throw sputtering configuration.

Although the FIB/SEM technique does not match the resolution of TEM, its significantly faster processing speed makes it invaluable. Possessing this metrology tool in-house enables us to perform exceedingly efficient and rapid optimizations of sidewall and bottom coverage, a critical advantage as feature sizes diminish and IC designs evolve into three-dimensional structures.

Method	System	Characterization of	Sample size
Atomic Force Microscopy (AFM)	Park Systems NX20	Topography, surface roughness	Up to 200mm
X-Ray Diffraction & Reflectivity (XRD & XRR)	Bruker D8 discover	Crystallinity & crystal orientation, thickness (5 - 150 nm), density	Up to 300mm
X-Ray Fluorescence Spectroscopy (XRF)	Rigaku XRF	Composition, thickness (sub nm - mm)	Up to 300mm
Scanning Electron Microscopy (SEM) / Focused Ion Beam (FIB)	Zeiss Crossbeam 550 L (Gemini II)	Topography, cross section / resolution: 2 nm / magnification 12x- 2E6x	Up to 300mm
Electron Dispersive X-Ray Spectroscopy (EDX)	BRUKER QUANTAX EDS (Xflash 410)	Composition	Up to 300mm
Ellipsometry	Woollam SE M-2000F / Sentech 500Adv, SE 800-PV & SENResearch 4.0	Optical properties (n,k), thickness (1 nm - 10 µm) / (wavelength range: 245-2500 nm)	Up to 300mm
4 point probe	4Dimensions Polytec 333A DI V5.5R1 / 4Dimension 280 TCI & 280 BM 1003 / KLA-Tencor OmniMap RS100	Sheet resistance (0.001 - 8E11 Ω/Sq)	Up to 300mm
Spectrophotometry	Perkin Elmer Lambda 950, 750, Spectrum II / Essentoptics GmbH Photon RT	Transmission, reflection (wavelength range: 175 - 3300 nm & 1200 - 28500 nm)	50 x 50mm
Reflectometry	ProMicron NanoCalc 300 / Mikropack Metrology Systems NanoCalc 2000	Film thickness (10 nm - 20 µm) / wavelength range: 210 – 2500 nm	Up to 300mm
Laser level & Interferometry	Frontier Semiconductor FSM 128L / KLA-Tencor Flexus FLX 2320 / Toho Technology FLX 3300-T	Wafer bow, radius, stress (1 - 4 gpa) / dual-laser	Up to 300mm
Optical Microscopy	ProMicron Leica INM 200	Particles (sensitivity: 1 µm)	Up to 200mm
Laser Light Scattering	UnitySC Lightspeed / NanoPhotonics Reflex 300 TT 150	Particles (sensitivity: 50 nm) / haze	Up to 300mm
Contact Stylus Profilometry	Veeco Dektak V 300 Si & V 150 / KLA-Tencor Alpha Step 500 & 600, P 16	Thickness (1 nm - 1200 µm) / stress	Up to 300mm
Profilometry	Eichhorn & Hausmann MX 204-8-21 V	Wafer thickness, bow, warp, TTV (Total Thickness Variation)	Up to 200mm
Magnetometry	Shb Instruments MESA 200 (in-plane) / Kerr magnetometer (self-made)	Magnetic properties	Up to 200mm
Contact Angle	Krüss FM40MK2 Easy Drop	Surface tension	Up to 100x100mm
Life timer	Sinton WCT120 & Suns-Voc 150	Life time of charge carriers in Si	Up to 200mm

Table 2: A wide ranging list of Thin Film characterization techniques

Want to know more?

To learn more about the new services available and to get a quote please email: philip.zeller@evatecnet.com