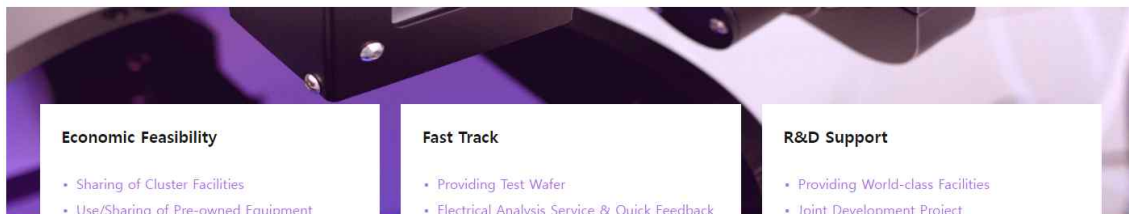


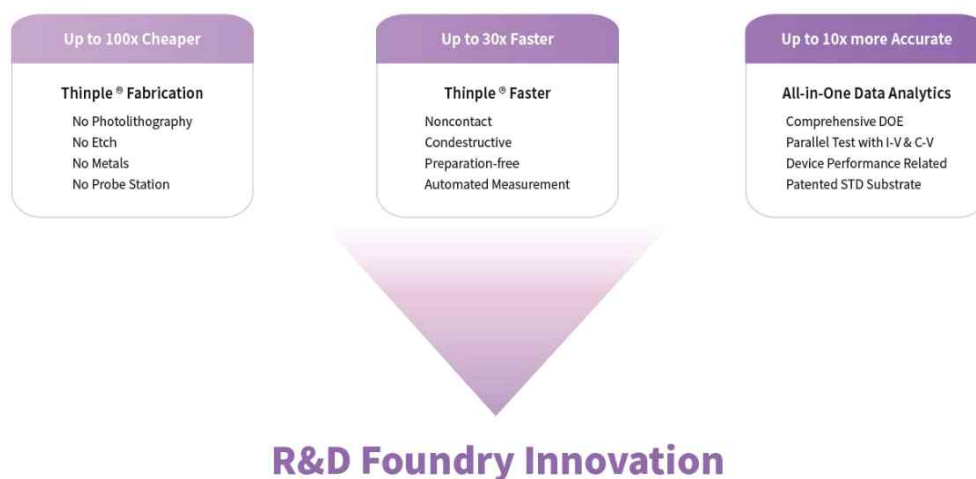
1. Why R&D Foundry

- SurplusGLOBAL intends to provide innovative R&D foundry services to customers who want to secure technological competitiveness while minimizing R&D CAPEX. By building a 300mm dedicated R&D fab in a cluster facility where semiconductor-related company employees and technical experts can always interact, we use legacy processes with high ROI, measurement equipment, and reliable brand-new electrical analysis equipment to solve technical difficulties desired by customers at low cost. , introduced a new concept called Manufacturing R&D that solves problems quickly and accurately.

Solutions We Offer



Minimizing R&D CAPEX / Providing Innovative R&D Foundry Services



2. Thin Film Test Wafer

- SurplusGLOBAL provides deposition process solutions for 300mm wafers with proven mass production equipment. We provide customized thin film deposition process services by providing basic standard recipes or adapting process recipes to suit your specific requirements. Through this, we provide verification service in mass production equipment when developing tools for process diagnosis and process parameter monitoring.

Correlation data can be obtained by matching process parameters and changes in thin film characteristics through TFW (Thin Film Wafer) measurement and electrical characteristic analysis conducted in the verification process. This is a service that provides a total solution that can connect equipment performance, recipe conditions, thin film quality, and device characteristics.

Thin Film Test Wafer



- Provides high quality 300mm thin film test wafer for product performance evaluation
- Provides new material film test wafer for the next generation
- Provides customized 300mm thin film deposition services
- Provides quality data of thin film using 300mm metrology and inspection tools

Stacked Structure	General Specification	Application	Remark
 <p>TEOS Oxide Si Substrate</p>	PE-TEOS Blanket - Diameter : 300mm - TEOS : 300Å ~ 40KÅ +/-3%	CMP Consumables Test - Removal Rate or Defect test of CMP slurry, pad, conditioner, etc.	Mass Production
 <p>Thermal Oxide Si Substrate</p>	Thermal Oxide Blanket - Diameter : 300mm - Oxide : 300Å ~ 10KÅ +/-3%	Depo. Process Monitoring Equipment / Materials Test Carrier Wafer in Package process	Mass Production
 <p>Low-k Oxide Si Substrate</p>	Low-k Blanket - Diameter : 300mm - Low-k : 500Å ~ 5KÅ +/-3% - k value : 2.7 ~ 3.0	CMP Consumables Test Depo. Process Monitoring Equipment / Materials Test	Available in OEM Plan to mass production in 2023
 <p>CVD W Si Substrate TiN TEOS Oxide</p>	CVD-W Blanket - Diameter : 300mm - W : 6KÅ ~ 7KÅ +/-3% - TiN : 200Å ~ 300Å - TEOS : 1KÅ ~ 2KÅ	CMP Consumables Test - Removal Rate or Defect test of CMP slurry, pad, conditioner, etc.	Available in OEM Plan to mass production in 2023
 <p>Cu-Electro Plate Si Substrate Cu Seed Layer Thermal Oxide</p>	Cu- Electro Plate Blanket - Diameter : 300mm - EP-Cu : 10KÅ ~ 15KÅ +/-3% - Cu Seed(PVD) : 500Å ~ 2KÅ - TaN : 200Å ~ 300Å - TEOS : 1KÅ ~ 2KÅ	CMP Consumables Test - Removal Rate or Defect test of CMP slurry, pad, conditioner, etc.	Available in OEM Plan to mass production in 2023

3. Services

- SurplusGLOBAL R&D Foundry intends to provide a variety of technical services, from manufacturing test wafers to technical consulting required in the process of developing core technologies for mass production of semiconductor products. Using clean room facilities at the level of semiconductor mass production line and 300mm dedicated process, measurement, and analysis equipment, we present reference points for key quality items (micro-defects, micro-contamination, interface characteristics, etc.), and diagnose and predict necessary technologies through systematic analysis. I'm focusing on that. The R&D Foundry is capable of providing customized technical services to customers, from verifying new materials, new ratios, and new process technologies in the early stages of development, to identifying the causes of defects in the

mass production stage, and optimizing mass production materials, mass production equipment, and mass production process technology necessary to strengthen product competitiveness.



- Provides various technical services from manufacturing standard thin film wafer for inspection and analysis to technical consulting
- Provides the cleanroom at the level of semiconductor mass production line, 300mm dedicated process, inspection and analysis services
- Suggests key quality index of device performance related quality and provides diagnosis and prediction of core technologies
- Provides total solutions to connect equipment performance, recipe conditions, thin film quality and device characteristics

Manufacturing R&D Total Solution Provider

Thin Film Device Characterization	Metrology & Inspection Service	Technology Consulting	Thin Film Process Service	Alpha-tool Test Bed
<ul style="list-style-type: none">• Noncontact and Nondestructive Electrical Characterization of Thin Film Quality• Mechanism Understanding of Quality Excursion• Pre-screening and Path-Finding of New Materials, New Equipment, New Processes	<ul style="list-style-type: none">• Film Thickness, Warpage, Stress Evaluation• Particle Counting• Metal Contamination• Plasma Damage Monitoring	<ul style="list-style-type: none">• DRAM, LOGIC, VNAND, CIS Technology Roadmap• Design of Experimentation• Substrate, Process, Device Engineering• Quality, Performance, Yield Improvement	<ul style="list-style-type: none">• 300mm Unit or Module Process Service• Process Equipment for In-situ Monitoring System, Chamber Characterization, RGA, EPD, FDC, MFC, Sensor, Parts, Components Evaluation• Data Mining, Machine-learning Application Development	<ul style="list-style-type: none">• R&D Local Fab for Alpha-tool Development• One-stop Tool Evaluation utilizing Thin Film Wafer and Thin Film Device Characterization• Demo Lab

3.1. Thin Film Device Characterization

- Since semiconductor product performance is related to the quality characteristics of materials, equipment, and processes, the impact on quality is identified through evaluation of electrical characteristics after the actual device is completed. However, for next-generation products, the device structure is more complicated than that of the previous generation, the process difficulty increases, and the proportion of new materials, extension ratios, and new processes is increased, resulting in a rapid increase in performance evaluation time and cost.

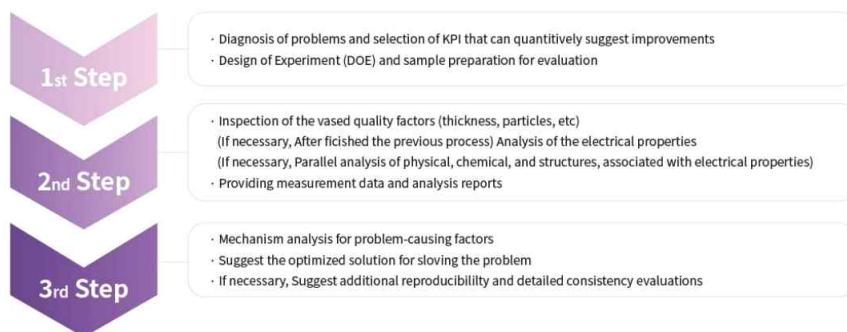
R&D Foundry innovation solution for next-generation technology development presents Thin Film Device Characterization that enables

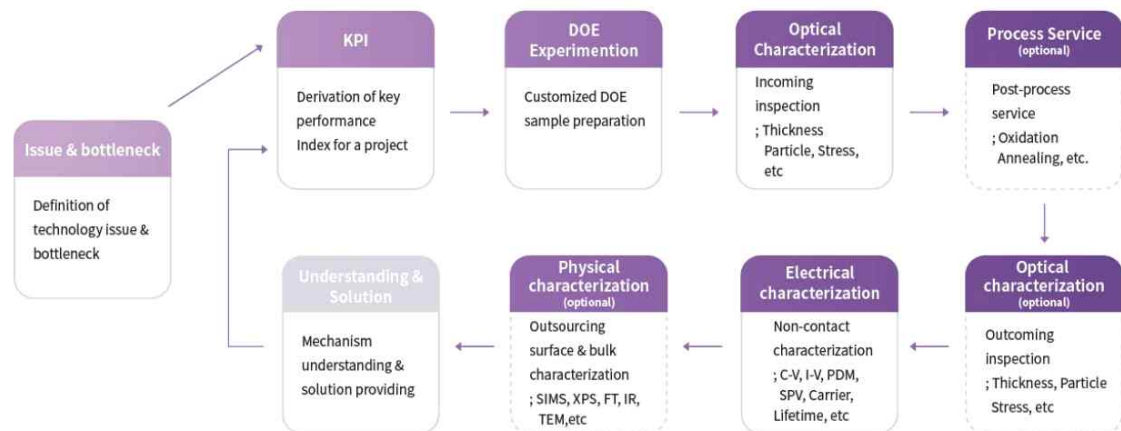
electrical characteristic analysis without the essential patterning process for device manufacturing. The Corona Discharge application method, which replaces the existing voltage application method, does not require an electrode pattern, so it has the advantage of being able to evaluate regardless of the type and generation of semiconductor products. Integrated analysis of key quality factors linked to product performance ensures results consistent with actual device evaluation results.

Thin Film Device Characterization



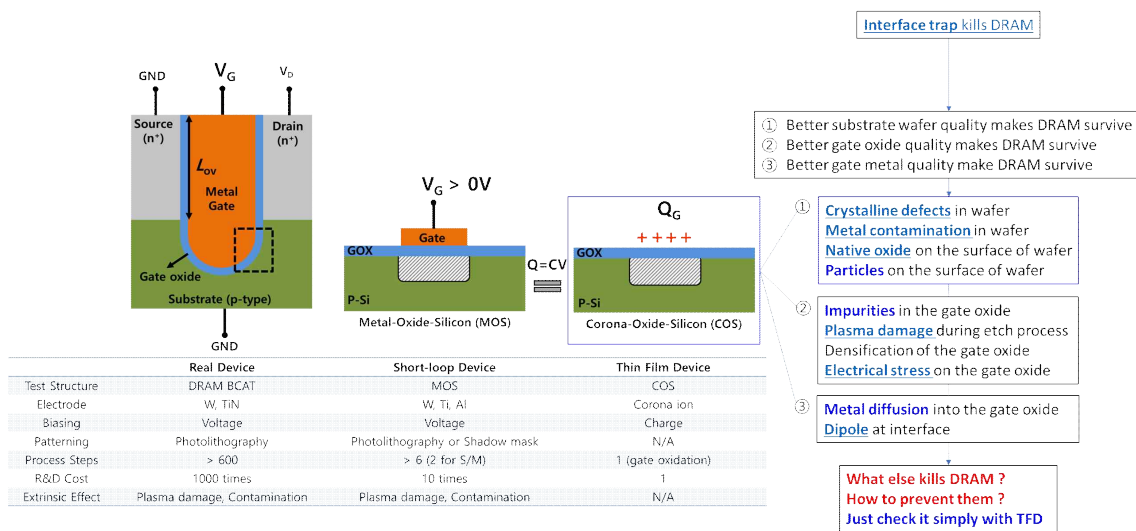
Provides Optimized Solutions for Solving Technical Challenges





※ R&D Foundry Thin Film Device Characterization Differentiation

- In the performance evaluation of existing semiconductor products, it was essential to analyze the electrical characteristics measured in the actual device structure. As a solution to this, we are using an indirect evaluation method in a simulated structure using a shorten process instead of an actual device. Although the MOS device structure is used to verify the quality characteristics of the gate oxide interface that directly affects the refresh time, which is one of the core performance of DRAM products, additional time and cost are consumed to form the electrode pattern even with a simple device structure, and the external patterning process is An error may occur in the analysis of the quality characteristics of the thin film itself depending on factors. The R&D Foundry utilizes the Corona Discharge application type thin film device characterization technology that does not require electrode patterns, so it can provide the optimal solution for verification and prediction of quality factors for various materials, equipment, and process conditions that affect actual device performance.



3.2. Metrology & Inspection Service

- SurplusGLOBAL is a measuring and analysis equipment dedicated to 300mm wafers, and by providing various analysis services for thin film wafers, it supports the development work and performance verification of semiconductor materials, parts and equipment companies, and contributes to localization.

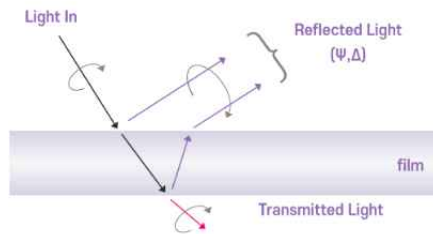
Metrology & Inspection Service



1. Measurement and analysis equipment for 300mm wafer
2. Provides various analysis services for Thin Film Wafer
3. Supports development work and performance verification of semiconductor materials, parts, and equipment companies

1. Film Metrology System

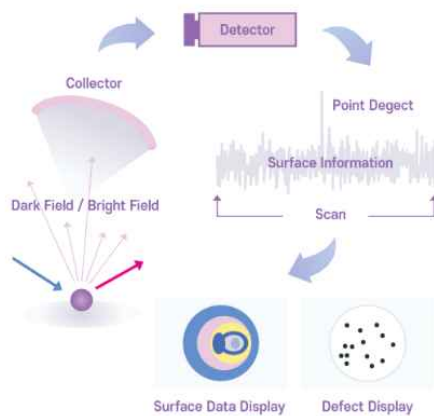
Measures the thickness, refractive index, Warpage and Stress of thin film to improve semiconductor product manufacturing process and product quality



- Broadband Spectroscopic Ellipsometer (BBSE) (240 ~ 900nm)
- White Light Reflectometer (WLR) (450 ~ 900nm)
- Film thickness
- Refractive index
- Warpage & Bow
- Stress measurement

2. Non-Patterned Wafer Defect Inspection System

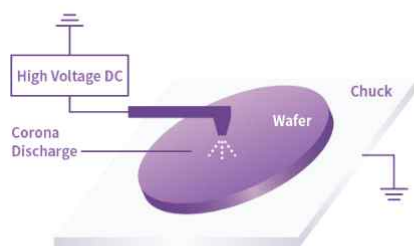
Contributes to performance improvement and reliability evaluation of semiconductor products by analyzing thin film wafer defect and surface quality



- Non-Patterned surface inspection system, 12"
- Defect sensitivity on polished bare silicon: 0.050 μm
- Enhanced rough film sensitivity
- ARGON Ion laser: 488 nm
- Defect map and histogram with zoom
- RTDC (Real Time Defect Classification)
- Particle counting

3. Non-Contact Measurement of Dielectrics and Interface Properties

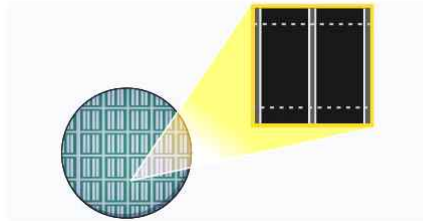
Contributes to improving the quality of oxide, nitride, and metal thin films of 300nm wafers through non-destructive, non-contact electrical characteristic analysis



- Dielectric Capacitance (CD) and Thickness (EOT)
- Dielectric Leakage Current (I-V)
- Flatband Voltage (V_{fb})
- Interface Trap Density (D_{it})
- Interface Trapped Charge (Q_{it})
- Semiconductor Surface Barrier (V_{sb})
- Oxide Total Charge (Q_{tot})
- Mobile Ionic Charge (Q_m), among others
- Heavy metal contamination

4. Critical Dimension Measurement

Used to measure dimensions in the nm range as well as dimensional analysis of materials



- Measurement method: Cursor or line profile method
- Measurement range: 50nm ~ 2μ m
- Measurement repeatability : $\pm 1\%$ or 2nm (3σ)
- Throughput : 24 wafers/hour
- Measurement points: 1/chip, 20 chips/wafer
- Image magnification : 1000 ~ 3000x

3.3. Technology Consulting

- Based on various semiconductor product technology road-maps, we set the direction of material and equipment development, and solve problems with our own technology, such as pre-diagnosis of problems that may occur when mass-producing the development technology, and identification of the root cause of high quality defects that reduce the quality and productivity of mass-produced products. We provide customized advisory services for difficulties that cannot be solved, and SurplusGLOBAL technical advisory can even be verified experimentally, so it is possible to provide reliable customer service.

Technology Consulting



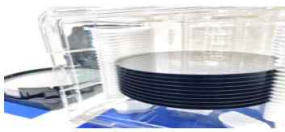
1. Setting the direction of material and equipment development based on the product technology roadmap
2. Pre-diagnosis of problems in mass production application; analysis of causes related to mass production quality and productivity
3. Provides customized advisory services for various difficulties
4. Reliable customer service available up to experimental verification

3.4. Thin Film Process Service

- SurplusGLOBAL provides deposition process solutions for 300mm wafers with proven mass production equipment. We provide customized thin film deposition process services by providing basic standard recipes or adapting process recipes to suit your specific requirements. Through this, we provide verification service in mass production equipment when developing tools for process diagnosis and process parameter monitoring.

Correlation data can be obtained by matching process parameters and changes in thin film characteristics through TFW measurement and electrical characteristic analysis conducted in the verification process. This is a service that provides a total solution that can connect equipment performance, recipe conditions, thin film quality, and device characteristics.

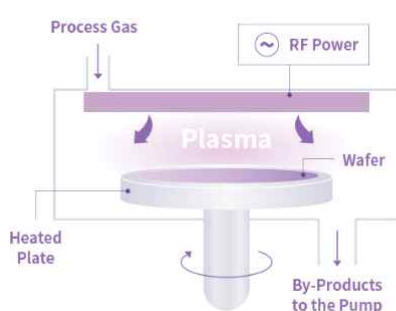
Thin Film Process Service



1. Provides deposition process solution for 300mm wafers with proven mass production equipment
2. Provides customized thin film deposition process services by applying process recipes suitable for requirements
3. Provides a total solution to connect equipment performance, recipe conditions, thin film quality and device characteristics

1. 300mm PE-CVD : TEOS Oxide Deposition

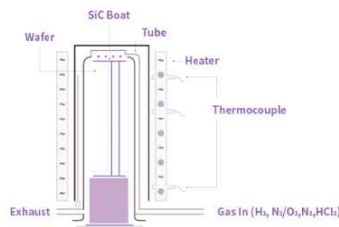
Low temperature compared to the thermal method; the thin film is deposited by converting the special gas into a plasma state in the high-pressure chamber



- Process : PE-TEOS oxide
- Wafer size : 12inch
- Temp control : ALN heater, 350 to 400°C
- Load port : 2port

2. 300mm Diffusion furnace : Thermal Oxidation(Dry/Wet)

It is a process of forming SiO_2 by supplying heat and an oxidizing agent (water, oxygen) to a Si substrate, and has excellent interfacial properties by replacing a part of Si with SiO_2 .



- Process : Thermal oxidation(Dry/Wet)
- Wafer size : 12inch
- Temp control : 5zone heater, 900 to 950°C
- Load port : 2port
- Max loading : 117wfs

3.5. Alpha-tool Test Bed

- Fab that can solve basic performance evaluation in the early stage of development in one stop by directly installing equipment that needs development in SurplusGLOBAL clean room free space and using optical and electrical measurement and analysis equipment possessed by SurplusGLOBAL. We provide rental service and our own R&D Fab. It is advantageous in preoccupation with customers because it can dramatically reduce cost and time compared to construction and maintenance, and differentiated customer service that provides performance evaluation results to customers who want a demo evaluation is also possible.

Alpha-tool Test Bed



1. Clean Room 1,752 m²(18,859 ft²) (100 ~ 100,000 Class)
- Expandable space 8,595 m² (92,516 ft²)
2. Direct installation and operation of equipment that needs development in the free space of SurplusGLOBAL cleanroom
3. Provides fab and rental services that can solve basic performance evaluation in the early stage of development with one-stop solution using measurement and analysis equipment of SurplusGLOBAL
4. Own R&D Fab. Significantly reduce cost and time compared to building and maintaining the new fab.

4. Fab Facility

Fab Facility

1. Operating 300mm semiconductor mass production process equipment. Fully equipped with Class 1,000 cleanroom and utilities.
2. Easy to configure customized spaces such as 10,000 Class cleanroom, refurbishment bays, and exhibition halls with constant temperature and humidity.
3. 24 hour environmental, safety and security management operation through the central control room
4. Create synergies through collaboration between cluster tenant companies

