MICROELECTRONICS SERVICE
QUALIFICATION AND RELIABILITY ASSESSMENT OF MICROELECTRONIC PRODUCTS
FOR CHEMICALS OF THE SEMICONDUCTOR PROCESS AND AUTOMOTIVE APPLICATIONS

Sam S.C. Chien, Ph.D.
CRS-EE-MICROELECTRONICS
SEMICONDUCTOR OPTOELECTRONIC SERVICES
ULTRA TRACE & INDUSTRIAL SAFETY LAB
New Development on Qualification and Reliability Assessment for **Chemicals** of the Semiconductor Process and Automotive Applications
SUCCESS

SGS是全球檢驗、查證、測試和驗證服務的領導品牌
Raw Materials
- Material IQC

FAB Total Solution
- Packaging Material Cleanliness
- Parts Cleaning Total Solution
- Cleanroom Total Solution
- AMC/VOCs
- Process Water, UPW
- Compress Dry Air, CDA
- Semi standard, e.g. S2, S8, S10, S22, and F21

Product
- Functional Safety
- Failure Analysis
PROTECTING THE FINAL PRODUCT

The quality of Microelectronics/medical materials depends on the absence of contamination from beginning to the end of the production process.
EFFECT OF THE CLEANLINESS DEGREE

Upon receiving a classification, the room must be maintained to meet the specifications for:

- Cleanliness
- Temperature
- Humidity
- Pressure
- Turnover number of air changes/hr.
- Flow rate (CFM)
CONTROLLING CONTAMINATION

- **Filtration**
  - Pre-filtered in air handling units
  - HEPA (High Efficiency Particulate Air) filtered prior to entering cleanroom
  - Removes 99.99% of particles (typically 0.3 µm)

- **Temperature**
  - Maintained to reduce microbial growth
  - (viruses, spores, fungi, bacteria)

- **Humidity**
  - Effects static, reduce filter efficiency, and growth of microbes
CONTAMINATION CONTROL

- Environmental Control
  - Atmospheric
  - Materials and supplies
  - Entrance and exit
  - Cleaning and maintenance

- Personnel Control
  - Activity
  - Personal Hygiene
  - Gowning
SOURCES OF CONTAMINATION

- Facilities:
  walls, floors, ceilings, paint, coatings, construction material (sheetrock, sawdust etc.), air conditioning debris

- Equipment/Supplies:
  Particles from friction and wear, lubricants oil & emissions, vibrations, brooms, mops, items brought into cleanroom, cleanroom debris

- People:
  Skin flakes and oil, hair, spittle, cosmetics & perfume, clothing debris (lint, fibers, etc.)
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CLEAN?

- When can the cleanroom be cleaned?
  - Need to work around production schedule
- How frequently does it need to be cleaned?
  - Depends on use
- What is clean and how is it measured?
SGS

TOTAL SOLUTION OF CLEANROOM

Clean Room Design

Approve the Effect

Clean up Clean Room

Training with Seminar

Build up Clean Room

Cleanroom by SGS

TOTAL SOLUTION OF CLEANROOM
SERIAL NO.: KDC30112
CLASS: ISO Class 3; at rest; 0.3um, 0.5um
TYPE: Laminar Flow Cleanroom
RELATIVE HUMIDITY: 50 % ± 10 %
TEMPERATURE: 20 °C ± 2 °C
SIZE: 
YEAR OF MANUFACTURE: Late 2012

Cleanroom by SGS
One to Three Year Warranty
Six Inspections with Test Reports
Training and Seminar for Maintain SGS Certification
TOTAL SOLUTION OF CLEANROOM

Clean Room Design

Build up Clean Room

Three Year Warranty

Clean up Clean Room

Training with Seminar

Approve the Effect

Cleanroom by SGS
SGS
CLEANLINESS OF PARTS CLEANING

Clients from Maker to User

Clean the Parts

Parts Cleaning by SGS

Cleanliness Test

Verify the Effect

Reuse the Parts
LOCATION OF SGS SEMICONDUCTOR ANALYSIS LAB FOR CHEMICAL TESTING

Taipei Lab
(ISO Class 6, 5, and 4)
@New Taipei Industrial Park

Tainan Lab
(ISO Class 5, and 3)
@Southern TW Science Park
Analytical MDL

- GC/MS · VOCs MDL = 3.2 ug/m³
- ICP/MSMS · element MDL = 1.0 ppt (B ~10.0 ppt, Si ~100 ppt)
- IC · anion/cation MDL = 10ppt
- Air particle, 0.1~25μm
Contamination (due to outgassing) in Vacuum Environment
- ASTM-E595

Other Standards:
- IPC-TM650-2.6.4: OUTGASSING, PRINTED BOARDS
- NASA General Specification No. SP-R-0022
- NASA SSP 30312
- ASML Standard Material for Semiconductor
ASTM-E595 OUTGASSING TEST

- **ASTM E595-15**
  

Outgassing test environmental requirements:

- Pre-set in 73 °F (23.8 °C) / 50% (24 hr)
- Test in 257 ±2 °F (125 °C), vacuum ≤ 5 x 10^{-5} torr (24hr)
- CVCM (collected volatile condensable materials) ≤ 0.1%
- TML (total mass loss) ≤ 1%
- WVR (the amount of water vapor regained)

Material: thermal pad, thermal conductive film, polymer mixture, foaming material, elastomer, film, tape, insulator, shrink tube, glue, paint, fabric, and roller oil.
FFF-ICP/MS FOR THE NUMBER/CONCENTRATION OF NANOPARTICLES AND THE TYPE OF ELEMENTS

Conditions:
- 60 nm Au ~83ppt
- 18 hrs detection of particle number is stable w/ median size ~60 nm.

Size distribution:
- Particle concentration
- Particle size
- Ionic concentration

Conditions: 60 nm Au ~83ppt

R² = 1

Graphs showing size distribution and signal distribution with NP type and ion type.
SGS IS THE WORLD’S LEADING INSPECTION, VERIFICATION, TESTING AND CERTIFICATION COMPANY.

WHEN YOU NEED TO BE SURE
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Total Solution by SGS
New Development on Qualification and Reliability Assessment for Chemicals of the Semiconductor Process and Automotive Applications

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MICROELECTRONICS & SPECIAL ANALYTICS

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SUCCESS

SGS IS THE WORLD'S LEADING INSPECTION, VERIFICATION, TESTING AND CERTIFICATION COMPANY

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AT A GLANCE

- Nº1 WORLD LEADER
- 97,000 EMPLOYEES
- 2,600 OFFICES AND LABORATORIES
- 11 GLOBAL INDUSTRIES
- GLOBAL SERVICE LOCAL EXPERTISE
ONE COMPANY – ONE BRAND

WHETHER WORKING WITH SGS OR ONE OF ITS SUBBRANDS SGS INSTITUT FRESENIUS AND SGS-TÜV SAAR, YOU WILL ALWAYS BENEFIT FROM THE ENTIRE NETWORK AND EXPERIENCE OF SGS. SGS: THE SYNONYM FOR RELIABILITY, SECURITY AND QUALITY.
Institut Fresenius GmbH goes back to the Laboratory Fresenius, founded in 1848 in Wiesbaden by Carl Remigius Fresenius, a famous savant of analytical chemistry.

Today SGS Institut Fresenius is a leading provider of non-medical laboratory analysis in Europe. Our expertise is reflected in more than 180 certifications, accreditations, and approvals, as well as 155 years of analytics experience.

This outstanding knowledge establishes - in Germany and internationally - our excellent reputation among manufacturers, retailers, service companies and end consumers.
SGS INSTITUTE FRESENIUS IN DRESDEN

The service lab with the longest experience in material, surface and thin film analysis.

- **1961** Foundation of the "Arbeitsstelle für Molekularelektronik" (molecular electronics laboratory)
- **1970-90** Microelectronics research center ZMD (Zentrum Mikroelektronik Dresden)
- **1.10.1990** Foundation of the Institute Fresenius site in Dresden

- **SGS - Société Générale de Surveillance**
- **2004** SGS INSTITUTE FRESENIUS GmbH
OUR EMPLOYEE

- Average experience in microelectronics > 10 years, with many > 25 years

- Division Manager: Mr. Gerald Dallmann
  Diploma in Microelectronics Technology in 1986
  Various leading positions in the industry (Siemens, Infineon, Qimonda).
  Director for Technology Development (DRAM)
  SGS since 2009

- Lab Manager: Dr. Andreas Krause
  Diploma and PhD in Material Science
  Solarworld 2005-2017
  SGS since 2017

- Business Development Manager Dr. Bernd Mehlich
  Diploma and PhD in Physical Chemistry 1986
  Nukem, Environmental analysis 1986 - 1998
  Institute Fresenius since 1998

- Senior Scientist Dr. Heiko Hortenbach
  Diploma (1999) and PhD (2003) in Physics
  Expert for SIMS at Infineon, Qimonda
  SGS since 2009. Expert for SIMS, XPS, AES, SRP…
Analytical lab service of physical and chemical analyses throughout the supply chain in microelectronics and related high-tech industries.

Analysis of:

- Surfaces
- Thin films and layers
- Micro structures
- Particles
- Process media
- Material analysis
CRS MICROELECTRONICS & SPECIAL ANALYTICS

Overview of our techniques

- Materialography, microscopy
- Scanning electron microscopy (SEM)
- Atomic force microscopy (AFM)
- X-ray diffraction (XRD)
- Transmission electron microscopy (TEM)
- Computer CT
- X-ray photo electron spectroscopy (XPS)
- Auger electron spectroscopy (AES/SAM)
- Electron probe micro analysis (EPMA)
- Secondary ion mass spectrometry (SIMS)
- Time-of-Flight Secondary ion mass spectrometry (ToF-SIMS)
- Spreading resistance profiling (SRP)
- Infrared spectroscopy (FTIR)
- Raman spectroscopy
- Thermal analysis (TGA, DMA, DSC)
- Chemical analysis IC HPLC, GC-MS, ICP-MS
- Solid phase micro extraction (VOC-Ident-SPME-GC-CIMS)
- Optical emission spectroscopy (F-OES)
Detection of particles in liquids, on medical devices and instruments and on support material (vails, tubes, packaging material, …)

Optical microscope analysis is following USP788 (Particulate matter in injections)

Additional methods: SEM/EDX, FTIR, Raman, XPS, TOF-SIMS, …

Examples: Analysis in a clean room lab
Examples: Analysis of semiconductor chips

- Characterization of Si-wafers
- Dopant profiling
- Layer characterization
- Characterization of interconnects
- Failure analysis of integrated circuits