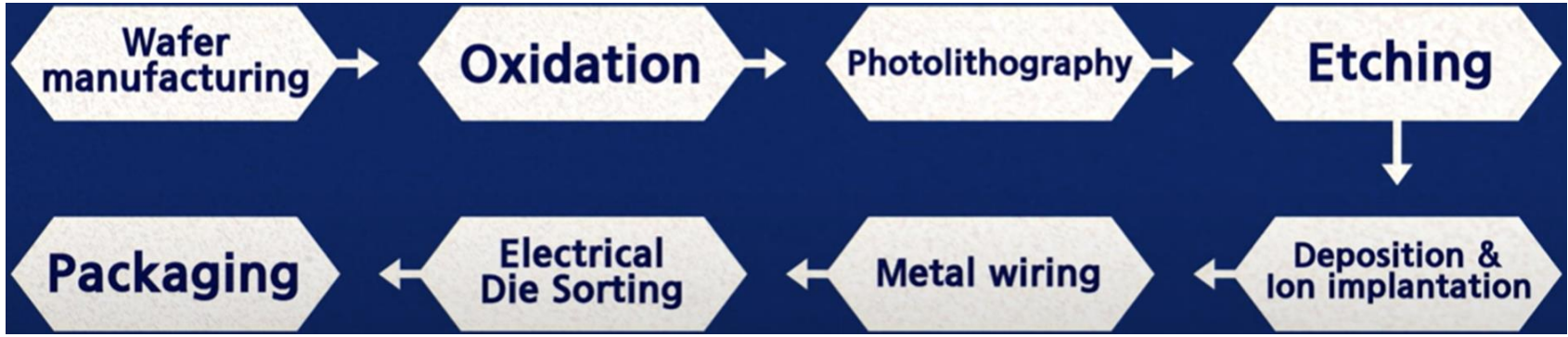
Chip Inspection Technology

Overview of chip manufacturing process & the related inspection technology

Key stages of chip manufacturing process

A complete semiconductor manufacturing process can be divided into the following main stages:

- Wafer Preparation Stage: including raw material preparation, wafer growth, wafer cutting and other steps.
- Front-End Processing Stage: including cleaning, surface treatment, photolithography, etching, deposition, diffusion/ion implantation and other steps.
- Middle process stage: including wafer surface cleaning, electrical performance testing, epitaxial growth, metallization, structure formation and other steps.
- Post-process stage: including packaging, testing, sorting, post-processing and other steps.



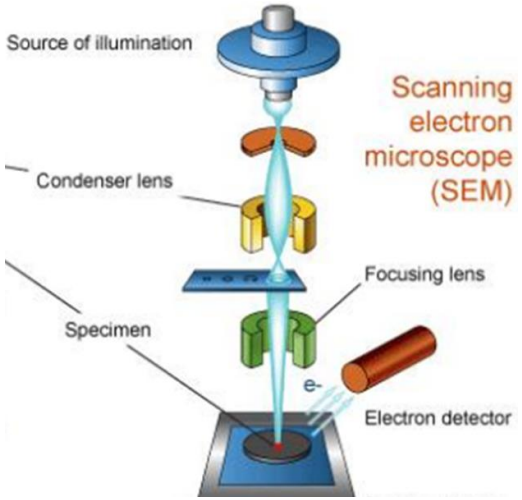
Wafer preparation stage & related inspection technology

Wafer growth

- Laser interferometer, X-ray diffractometer (XRD), etc. are required to detect the crystal structure and purity.

Wafer cutting

- Wafer thickness measurement tools: Such as optical systems, to ensure uniform wafer thickness.
- Surface inspection systems: Like optical inspection tools or scanning electron microscopes (SEMs), to check for defects, particles, or contamination on the wafer surface.



Scanning electron microscopes

Wafer preparation stage

& the related inspection technology

- Wafer growth
  - Detect the crystal structure and purity
    - **Laser interferometer**
    - **X-ray diffractometer (XRD)**
- Wafer cutting
  - Wafer thickness measurement tools to ensure uniform wafer thickness
    - **3D optical systems**
  - Surface inspection systems to check for defects, particles, or contamination on the wafer surface
    - **Optical inspection tools**
    - **Scanning electron microscope (SEM)**

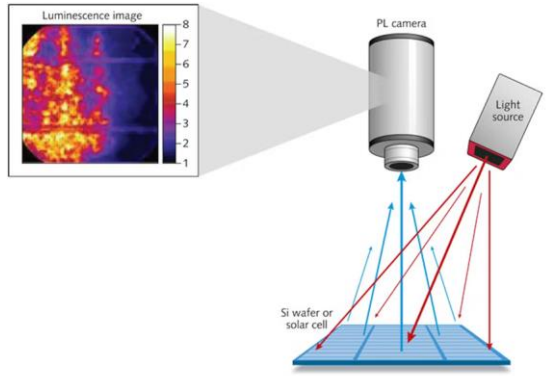
Front-end processing stage & related inspection technology

Cleaning

- Chemical analyzers, optical surface profilometers, etc. are required to remove surface contaminants.

Surface treatment

- UV-visible spectrometer, fluorescence spectrometer, etc. are required to detect specific electrical and optical properties.



Fluorescence spectrometer

Photolithography

- Microscopes, atomic force microscopes, etc. are required to detect the quality and accuracy of photolithography patterns.

Etching

- Electron microscope, scanning probe microscope, etc. are required to detect the etching quality and depth.

Deposition

- Surface profilometer, X-ray diffractometer, etc. are required to detect the thickness and structure of the deposited layer.

Front-end processing stage

& the related inspection technology

Cleaning	Remove surface contaminants	Chemical analyzers Optical surface profilometers
Surface treatment	Detect specific electrical and optical properties	UV-visible spectrometer, Fluorescence spectrometer
Photolith-ography	Detect the quality and accuracy of photolithography patterns	Microscopes Atomic force microscopes
Etching	Detect the etching quality and depth	Electron microscope Scanning probe microscope
Deposition	Detect the thickness & structure of the deposited layer	Surface profilometer X-ray diffractometer

Middle process stage & related inspection technology

Annealing

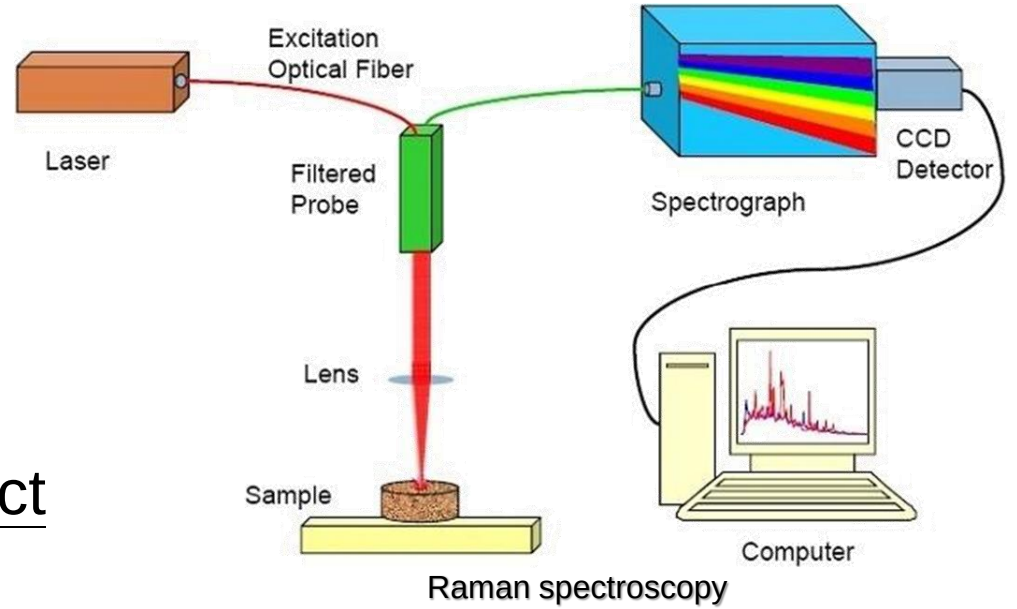
- Raman spectroscopy, electron microscopy, etc. are required to detect the wafer quality.

Metallization

- X-ray diffractometer, electron paramagnetic resonance instrument, etc. are required to detect the structure and properties of the metal layer.

Electrical performance testing

- Probe testers, Hall effect testers, etc. are required to detect the resistance, capacitance, Hall effect and other electrical properties of the chip.



Middle process stage

& the related inspection technology

- Annealing
  - Detect the wafer quality
    - **Raman spectroscopy**
    - **Electron microscopy**
- Metallization
  - Detect the structure and properties of the metal layer
    - **X-ray diffractometer**
    - **Electron paramagnetic resonance instrument**
- Electrical performance testing
  - Detect the R, C, Hall effect & other electrical properties of the chip
    - **Hall effect testers**
    - **Probe testers**

Post-process Stage & related inspection technology

Packaging

- Infrared spectrometers, optical microscopes, surface profilometers such as 3D line confocal scanner, etc. are required to detect the quality and sealing of the packaging.

3D line confocal scanner

Testing

- Capacitance measuring instruments, resistance measuring instruments, Hall effect measuring instruments, X-ray diffractometer, etc. are required to detect the electrical properties, structure and purity of the chip.

Post-process Stage

& the related inspection technology

- Packaging
  - Detect the quality and sealing of the packaging
    - **Infrared spectrometers**
    - **Optical microscopes**
    - **Optical surface profilometers ex. 3D line confocal scanner**
- Metallization
  - Detect the electrical properties, structure and purity of the chip
    - **R & C measuring instruments**
    - **Hall effect testers**
    - **X-ray diffractometer**

Thanks for your listening

Final Testing and Quality Assurance Stage

In this stage, packaged devices undergo comprehensive electrical testing and quality assurance checks. Inspection equipment needed:

- Burn-in systems: Used to stress test packaged devices under accelerated conditions to identify early failures and ensure reliability.
- Final electrical test systems: Including ATE, to perform functional tests, parametric tests, and reliability tests on the packaged devices.
- Optical inspection tools: To visually inspect packaged devices for defects, such as cracks, delamination, or wire bond issues.