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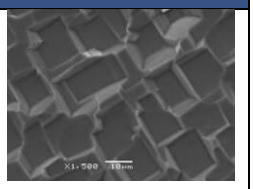
Semiconductor and printed electronics processing technologies

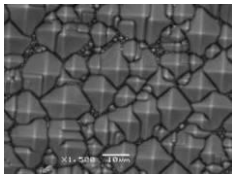
Wet Chemical Processes

Description:

□ Batch wet-bench processes

Processes:





- Saw damage etching of silicon substrate in KOH solution
- Selective alkaline etching of silicon substrate leading to a pyramid structure – textured surface
- Sequential wafer cleaning - in bath of aqueous solutions NH_4OH, H_2O_2, HF, HCl
- Wafer drying in spin rinse dryer and in hot air oven with forced circulation

Class purity: ISO Class 4
Capacity: 100 substrates per hour
Handling: batches, PP and PFA carriers for 25 wafers - 5 and 6 inch size

High Temperature Processes

Description:

Equipments for high temperature processes used in production of solar cells and other semiconductor devices are installed in clean room.

Processes:

- $POCl_3$ and BBr_3 diffusion
- LPCVD a PECVD deposition of dielectric layers
- Thermal oxidation (optionally)

Class purity: ISO Class 3

Deposition of Dielectric Layers - PECVD

- Single tube furnace
- Quartz tube 300mm in diameter
- Vacuum system with dry pump Adixen
- Advanced process control system for control and monitoring of process parameters via touch terminal
- Substrates are loaded on a graphite boat moved into quartz reactor
- Vacuum-tight doors are part of the loading system
- Multisource gas board
- RF power generator – 450kHz

Process:

- PECVD one-side deposition of thin dielectric layers - SiNx, SiOx, AlOx
- Processing temperature up to 450°C

Substrate: crystalline silicon wafer, formats 125x125 mm and 156x156 mm

Capacity: 108 substrates per hour
Producer: SVCS Process Innovation s.r.o. (CZ)

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Three Tubes Furnace for High Temperature Processes – Diffusion and LPCVD

- Quartz tube with diameter of 300 mm
- Advanced control system controlling all process parameters via touch terminals
- Substrates loaded on quartz boats are moved on silicon carbide paddle into individual quartz reactors
- Vacuum system with dry pump Adixen for LPCVD
- Liquid sources for diffusion processes

Process tube A:

■ LPCVD deposition of dielectric layers, Si_3N_4 a SiO_2, at temperatures up to 800°C (position L)

Sample: crystalline silicon wafers, quartz boats for wafers 125x125mm and 156x156mm
Capacity: 200 substrates per hour

Process tube B:

■ Creating a PN junction by $POCl_3$ diffusion at atmospheric pressure and at temperatures up to 950°C (position M)

Sample: crystalline silicon wafers, quartz boats for wafers 125x125mm and 156x156mm
Capacity: 300 substrates per hour

Process tube C:

■ Creating a PN junction by BBr_3 diffusion at atmospheric pressure and at temperatures up to 1050°C (position H)

Substrate: crystalline silicon wafers, quartz boats for wafers 125x125mm and 156x156mm
Capacity: 200 substrates per hour
Producer: SVCS Process Innovation s.r.o. (CZ)

Three Tubes Diffusion Furnace with Automatic Loading System

- Advanced control system controlling all process parameters via touch terminals
- Soft landing loading system
- Liquid sources for diffusion processes

Process:

■ Creating a PN junction by $POCl_3$ diffusion at atmospheric pressure and at temperatures up to 950°C

Substrate: crystalline silicon wafer, format up to 156 x 156 mm^2

Capacity: 600 substrates per hour
Producer: Centrotherm (D)

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Thin Film Technology

Deposition of Thin Layers by Magnetron Sputtering

Sputtering system:

- 0,75m3 chamber with rotating holder
- Two positions for targets
- Huettinger DC sources with SPARKLE pulse unit
- PinnaclePlus pulse source-frequency up to 350 kHz
- Rotary and turbomolecular pump PFEIFFER
- Manual loading/unloading

Processes:

- Deposition of metallic and dielectric thin layers
- Holder for flat substrates

Substrate: various substrates, format up to 125 x 125 mm^2

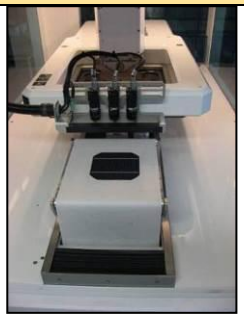
Capacity: 20 substrates per cycle

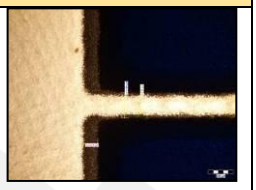
Thick Film Technology

Screen Printing

Equipment type A:

- Semiautomatic screen printer Baccini (IT)
- Squeegee movements by linear motors
- Vacuum printing table with protective paper
- Visualization system for very precision positioning print
- Manual loading





Processes:

- Printing of functional layers
- Printing area 200x200 mm
- Minimal printed line width - 40 mm
- Printing accuracy – 10 mm
- Designed for 12” screens with alu frames

Substrate: crystalline silicon wafer, ceramic substrates, flexible substrates, …

Capacity: 80 prints per hour
Number of units: 1

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Equipment type B: • Automatic screen printer Baccini • Twin table system • Vacuum printing table with protective paper • Visualization system for very precision positioning print • Possible manipulation with substrates by walking beam • Squeegee movements by linear motors 	**Processes:** • Printing of functional layers • Printing area 200x200 mm • Designed for 12” screens with alu frames **Substrate:** crystalline silicon wafer, ceramic substrates, flexible substrates, … **Capacity:** 1.00 prints per hour **Number of units:** 3
Drying of Thick Film Pastes	
• Dryer produced by Baccini (IT) • Substrates loaded on metal plates moved by side chains	**Process:** • Drying of metallic and other functional pastes **Substrate:** crystalline silicon wafers, ceramic and glass substrates **Capacity:** 1.000 substrates per hour **Number of units:** 2
Annealing and Sintering of Thick Film Pastes	
Equipment A: □ Continuous belt IR furnace **SVCS** - contains seven individually controllable temperature zones, which are planted with linear halogen tubes - allows to adjust the dynamic temperature profile and the maximum temperature about 950°C - belt width 495 mm - manual loading/unloading 	**Process:** • Sintering of dried metallic and other functional pastes by annealing in the continuous belt IR furnace **Substrate:** crystalline silicon wafers, ceramic and glass substrates **Capacity:** 500 substrates per hour

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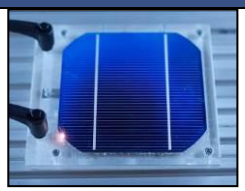
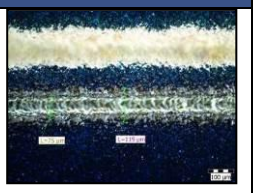
Equipment B: • Continuous belt IR furnace Centrotherm • Contains five individually controllable temperature zones • Heated by linear halogen tubes • Adjustment of dynamic temperature profile with peak temperature 1.000°C • Wire conveyor belt with width of 600 mm • Machine handling system with output camera	**Process:** • Sintering of dried metallic anf functional pastes by annealing in the continuous belt IR furnace **Substrate:** crystalline silicon wafers, ceramic and glass substrates **Capacity:** 1.000 substrates per hour

Laser Technology

Equipment: • The fiber-laser power of 20W and the wavelength of 1063 nm. Laser beam is deflected by galvo head, workspace size 180 x 180 mm2 • Manual loading/unloading 	**Processes:** • Cutting, scribing and drilling of various substrates and solar cells • Creating microstructures (isolation of PN junction, scoring, piercing holes)  **Substrate:** crystalline silicon wafers, ceramic and glass substrates, format up to 156 x 156 mm^2 **Capacity:** 100 substrates per hour

PV Modules Production

Stringing

Equipment: • Semiautomatic soldering head with step movement • Soldering by focused IR light	**Processes:** • Soldering of interconnection ribbons on solar cells • Assembling of strings of crystalline silicon solar cells **Substrate:** crystalline silicon solar cells, format up to 156 x 156 mm^2 **Capacity:** 12 strings per hour

Vacuum Lamination

• Vacuum membrane laminator ICOLAM 38/24 produced by Meier Group • Chamber size: 4.130 x 2.780 x 170 mm • Electrically heated bottom plate	**Processes:** • Lamination of PV modules **Substrate:** glass / back sheet modules **Capacity:** 8 modules per hour

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DIAGNOSTIC TOOLS

Measurement of IV Curves of Solar Cells

Equipment:

- Sun simulators and equipment for measurement of IV curves
- Two testers of solar cells
- Sun simulators with Xelamp, continuous operation, intensity 1000W/sqm

Measurement:

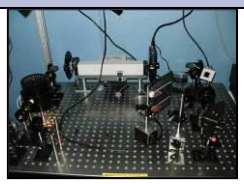
- IV curves in the lighting solar simulator
- Characteristics in bright or dark
- Series resistance with IEC

Sample: solar cell, format up to 156 x156 mm^2
Capacity: 100 solar cells per hour

Measurement of Quantum Efficiency

Equipment:

- Single grating monochromator
- Halogen lamp for the probe and bias light beams
- Optical components (mirrors, lenses and filters) from Edmund Optics
- Chopper and lock-in technique



Measurement:

- Quantum efficiency of solar cells
- Optical reflection of silicon substrates and solar cell structures in the spectral range 400-1200 nm

Sample: crystalline silicon solar cells, format up to 125 x 125 mm^2

Mapping of Minority Carriers Lifetime and Sheet Resistance

Equipment:

- WT2000 by Semilab
- Mapping tool

Measurement:

- Mapping of lifetime of minority charge carriers by method MWPCD (Microwave Photoconductive Decay)
- Mapping of sheet resistance
- (SHR method, non-contact and non-destructive

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Measurement of Minority Carriers Lifetime

Equipment:

- WCT120 by Sinton Consulting

Measurement:

- Measurement of minority charge carriers by method QSSPC
- (Quasi Steady State PhotoConductivity)
- Measurement Suns-Voc
- Dependence of the generated open circuit voltage on illumination for the generation of pseudo V-A characteristics and fitting of diode characteristics of solar cells and parallel resistance

Sample: solar cell, crystalline silicon wafer

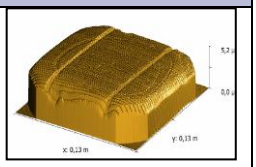
LBIC

Equipment:

- LBIC (Light Beam Induced Current)

Measurement:

- Mapping of the current response of the solar cells in the local monochromatic light irradiation



Measurement of Layer Resistance

Equipment:

- Four-probe scanner

Measurement:

- Coarse mapping of N+/ P+ layer esistance by four-probe method

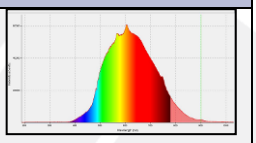
Measurement of Spectroscopic Analysis

Equipment:

- Spectra Suite Spectrometer

Measurement:

- Absorbance, reflectance and emission, as well as absolute irradiance, color and chemical concentration



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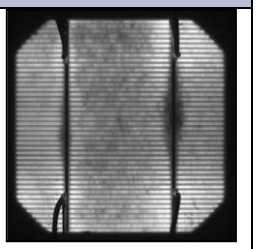
Electroluminescence Imaging

Equipment:
- High resolution CCD camera

Measurement:
- Electroluminescence images of solar cells and PV modules



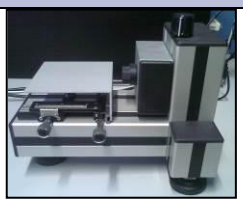
Optical Microscopy

Equipment:
- Optical microscope

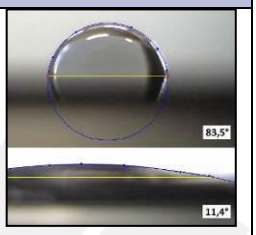
Measurement:
- Microscope with digital camera and software for capturing of images with great depth of field (Deep-focus)

Measurement of Surface Tension

Equipment:
- Apparatus for measuring the contact angle by Advex Instruments



Measurement:
- Measuring of the contact angle and evaluation of surface tension



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