SILEX

IPA-Free Wet Process Equipment for Cleaning, Texturing and PSG Removal

SINGULUS

Smart Solutions to Drive the Future.

Smart Solutions for Crystalline Silicon Solar Technology

Today's dominating solar cell concept is based on cells made from crystalline silicon. SINGULUS STANGL SOLAR provides complete automated dry-in/dry-out solutions for wet treatment of Si-wafers in standard and high-efficiency cell lines. Batch-type working Wet Benches (WB -series) are the "workhorses" for cleaning and etching processes in Si cell technology.

The new generation of the SILEX machine is characterized by a multitude of advantages compared with traditional wet-chemical texturing systems: due to the lack of volatile, easily inflammable solvents the construction of the system as well as the process control are facilitated.

The new texturing process provides extremely stable and reproducible process results.
In particular in terms of the achieved surface quality of the silicon cells, the etching machine meets the highest demands of the photovoltaics industry. Last but not least, the applied processing chemicals make the waste disposal of etching solutions easier compared to traditional systems. These factors are reflected in high cost efficiency of the new texturing process.

The SILEX system achieves an output of up to 3,000 wph and is characterized by low scrap rates of less than 0.05 % as well as homogenous etching results. With a wafer thickness of around 150 µm the SINGULUS STANGL SOLAR plant meets the current requirements of modern mass production in the silicon solar technology. The compact size as well as the modular design enable a space-saving and efficient integration of the machine into existing production lines.

The core of the modified SILEX system is a new IPA-free texturing process offering substantial cost advantages compared to traditional etching systems. This texturing process completely refrains from using flammable, volatile solvents such as Isopropanol (IPA) and enables a stable, wet-chemical texturing process for silicon wafers on the basis of commercialized additives.

SILEX – IPA-Free Wet Process Equipment for Cleaning, Texturing and PSG Removal

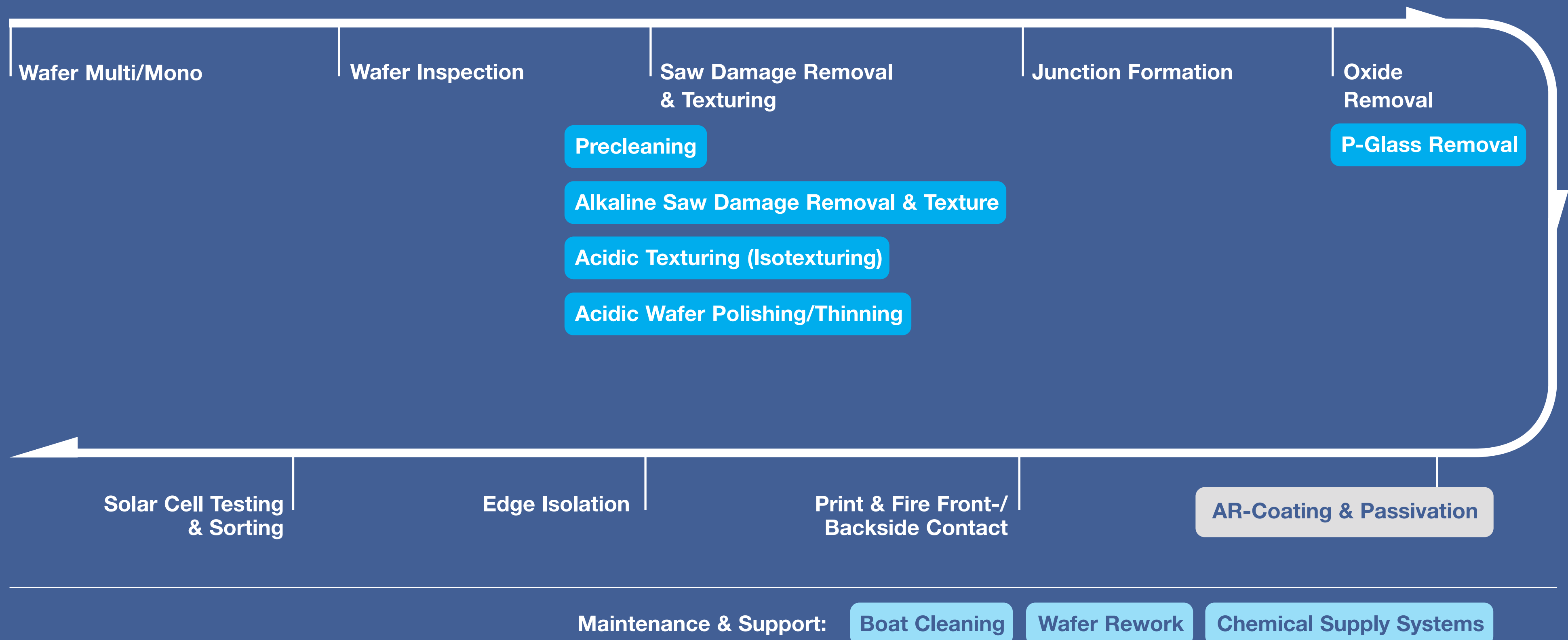
With the application of this alkaline texturing process the etching solution lifetime is tripled for the modified SILEX etching system with a shortening of the etching duration at the same time. Accordingly, the production costs for mono-crystalline silicon solar cells are substantially reduced.

Main Features

_ Proven, highly integrated design
_ High throughput up to max. 3,000 wph
_ High availability (uptime > 95 %)
_ Low breakage rate (< 0.05 %)
_ High flexibility in process sequence, wafer type, wafer size
_ Wafer thickness down to 150 µm
_ Internal automatic chemical bath management
_ Reproducible process results by complex process parameter control
_ Network communication support
_ Carrier tracking and data logging
_ Compliance with international safety regulations

Wet Process Machines in c-Si Solar Cell Production Lines

Si-Cell Production: SILEX SINGULAR



Maintenance & Support: Boat Cleaning | Wafer Rework | Chemical Supply Systems

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Main Components

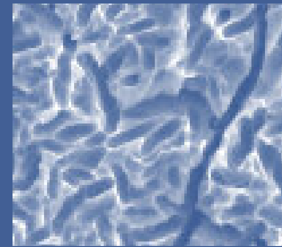
1 Housing
_ Stable modular main frame, completely covered by PP-panels
_ Main systems for bath management, electrical cabinets and process control units are integrated into housing
_ Safety gas sensor system for detection of harmful gas concentrations (NOX, H_2, HF)

2 Load / Unload Conveyor
_ Manual or automated feed-in and take-out of wafer carriers
_ Integrated carrier buffer
_ Safety interlock of human or automation interaction
_ RFID transponder identification

3 Central Robot Handling
_ Automated AC servo booster handling system guarantees quick, reliable and gentle carrier motion
_ Up to 3 parallel working x-z-robots
_ Sensitive crash protection sensor system

4 Pre Texture Clean
_ Initial cleaning and surface conditioning of incoming wafers material in hot alkaline cleaning mixtures
_ Optional ultrasonic power integration for improvement of cleaning efficiency

5 Alkaline Texturing (ALTEX)
_ Preferably dedicated for texturing of monocrystalline Si wafers
_ Removal of crystalline surface defects, forming random pyramides
_ Uniform etching
_ Compliant to international safety standards for atmospheres



6 Acidic Texturing (ISOTEX)
_ Preferred process for state-of-the-art texturing of multicrystalline Si wafers
_ Removal of crystalline surface defects by using HF-HNO_3 mixtures
_ Excellent temperature control
_ NOX-emmisson control during ongoing process and carrier transfer

7 Porous Si Etch (PorSi)
_ Short dip-treatment in a cold alkaline solution etches off the thin layer of porous silicon, caused by previous isotexturing step

8 Post Texture Clean
_ Using HF and HCl for effective removal of metal contaminations and native oxides

9 Oxide Etch (PSG removal)
_ Removal of P-doped SiO_2-layer from wafers, formed during previous POCl-diffusion
_ Self-limiting ambient DHF etch step

10 Rinsing
_ Optimized rinsing technology in terms of
  _ Fresh water flow
  _ Partial water reclaim
  _ Mechanical support and temperature enhancements
_ Intelligent combination of highly effective dump-spray rinse and water-saving multi-cascade overflow rinse

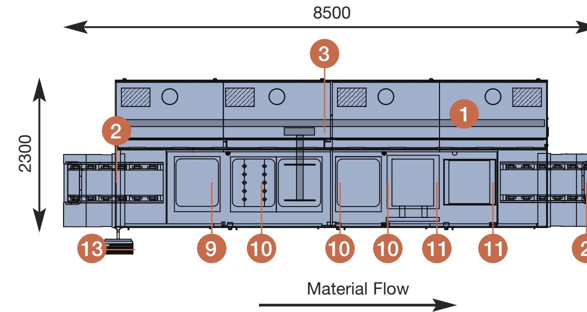
11 Drying
_ Stress-free 2-step drying process ensures perfect uniform, chemical and spot-free drying of wafers down to 150 µm with lowest risk of breakage
_ Compatible with all common low surface carrier types

12 Integrated Process Control
_ Weight determination of wafer carriers pre- and post process for internal etch rate control
_ Individual chemical bath management for filling and spiking of chemicals and DI-water
_ Temperature control of all heated and cooled process steps
_ Control of recirculation and injection flow rates
_ Individual process time control
_ Optional online/offline analysis of chemical compositions by titration, conductivity measurement and/or IR spectroscopy
_ Resistivity measurement
_ Process data storage and logging

13 Central Machine Control Systems
_ Siemens SIMATIC S7 PLC system
_ PC-based graphical user interface (WINCC)
_ Bus systems for internal communication of sub-assembly systems
_ OPC interfaces for external data exchange

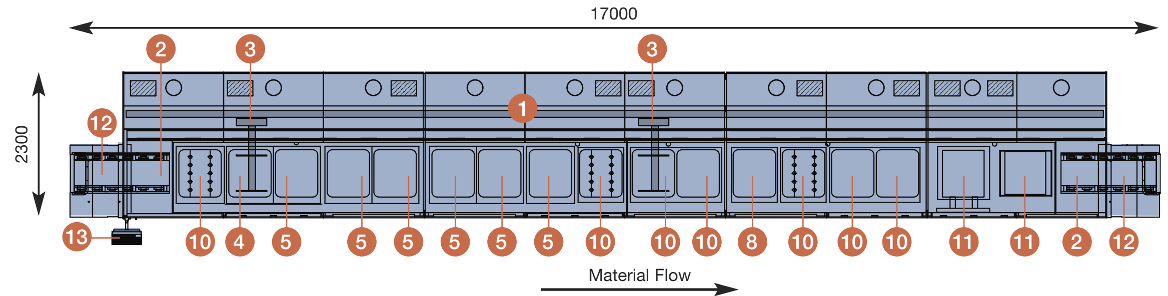
Main Features	WB-PSG1500 RL/LR	WB-PSG3000 RL/LR
Dimension L/W/H mm:		
Wet bench	6700/2300/3060	8500/2300/3060
Option sump pump tank	within footprint	within footprint
Capacity max.:	1500 wph	3000 wph
Wafer Material:	Si, mono, multi, 156 x 156 mm, > 150 µm	
Batch Size:	100 wafer	200 wafer
Utilities:	N_2, CDA, DI-water HF waste drains electrical power 400 VAC 3/PE	
Exhaust:	2700 m^3/h	3600 m^3/h
Typical Cycle Time:	270 s	270 s

WB-PSG



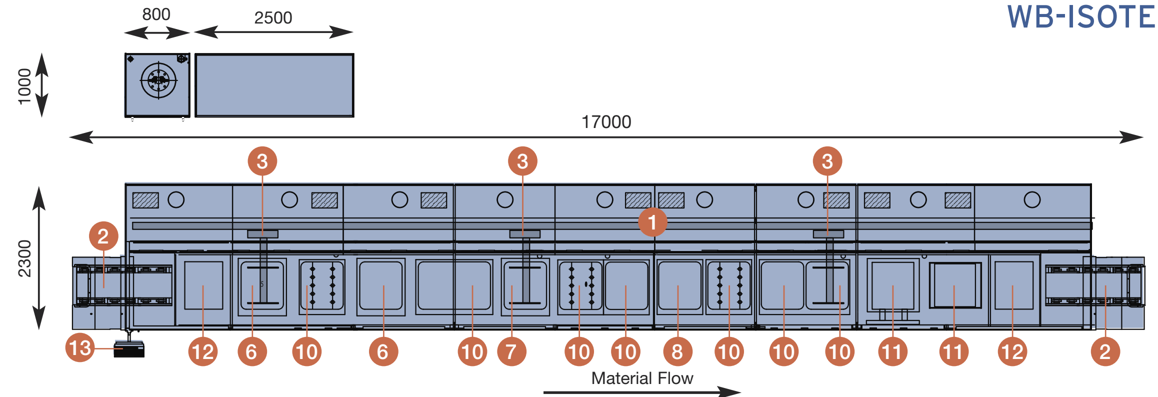
Main Features	WB-ALTEX1500 RL/LR	WB-ALTEX3000 RL/LR
Dimension L/W/H mm:		
Wet bench	13000/2300/3060	17000/2300/3060
DI-water heater	800/600/1600	2500/1000/2300
Option sump pump tank	2500/500/600 per unit	2500/500/600 per unit
Capacity max.:	1500 wph	3000 wph
Wafer Material:	Si, mono, multi, 156 x 156 mm, > 150 µm	
Batch Size:	200 wafer	200 wafer
Utilities:	N_2, CDA, DI-water, PCW, tap water HF, KOH, HCl, Additiv, H_2O_2 waste drains electrical power 400 VAC 3/PE	
Exhaust:	8000 m^3/h	9500 m^3/h
Typical Cycle Time:	270 s	270 s

WB-ALTEX



Main Features	WB-ISOTEX1500 RL/LR	WB-ISOTEX3000 RL/LR
Dimension L/W/H mm:		
Wet bench	15000/2300/3060	17000/2300/3060
Chiller station	800/1200/1500	2500/1400/1200
Day tank	integrated	1000/1000/2500
Option sump pump tank	2500/500/600 per unit	2500/500/600 per unit
Capacity:	1500 wph	3000 wph
Wafer Material:	Si, multi, 156 x 156 mm, > 150 µm	
Batch Size:	200 wafer	200 wafer
Utilities:	N_2, CDA, DI-water, PCW, tap water HF, KOH, HCl, HF, HNO_3, (HAc) waste drains electrical power 400 VAC 3/PE	
Exhaust:	6500 m^3/h	8500 m^3/h
Typical Cycle Time:	120-270 s	120-270 s

WB-ISOTEX



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