

SILEX III

Advanced Wet Processing



ALKALINE TEXTURING

The core of the current and future batch process applications is the alkaline texturing process of mono-crystalline silicon, generating pyramidal-etched surfaces with optimal light trapping, passivation and contacting properties.

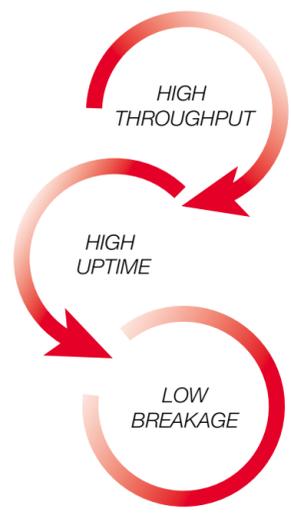
STATE-OF-THE-ART TEXTURING ADDITIVE

- » Commercially available, worldwide supported
- » Multiple pyramid size tuning options
- » Short and robust etching process with large process window and close uniformity range
- » Stable composition with long bath lifetime
- » Non-hazardous, non-flammable, non-dangerous
 - › Readily biodegradable

OZONE CLEANING

Ozone is one of the most powerful oxidizing agents. Effective Ozone-gas injection, low chemical concentrations and ambient process temperatures guarantee stable and highly effective process sequences for oxidation, cleaning and etching.

- » Reduced CoO cost saving effect vs. RCA cleaning (high chemical cost)
- » Higher minority carrier lifetime (combined Si etch-back and advanced cleaning)
- » Smaller machine footprint (reduced number of process tanks)
- » Improved surface passivation
- » Environmentally friendly process using



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SINGULUS TECHNOLOGIES - Thin-Film Coating and Surface Treatment

SINGULUS TECHNOLOGIES develops and assembles innovative machines and systems for efficient thin-film coating and surface treatment processes, which are used worldwide in the Photovoltaics, Semiconductor, Medical Technology, Packaging, Glass & Automotive as well as Battery & Hydrogen markets.

The company's core competencies include various processes of coating technology, surface treatment as well as wet-chemical and thermal production processes. SINGULUS TECHNOLOGIES sees sustainability as an opportunity to position itself with innovative products. In the focus are:

- » Environmental awareness
- » Efficient use of resources
- » Avoidance of unnecessary CO₂ pollution

SINGULUS TECHNOLOGIES attaches great importance to responsible and sustainable corporate governance.



1/2023 Studio Krause - Printed in Germany - Technical alterations reserved



SILEX III

Batch Wet Processing
System for Solar Cells



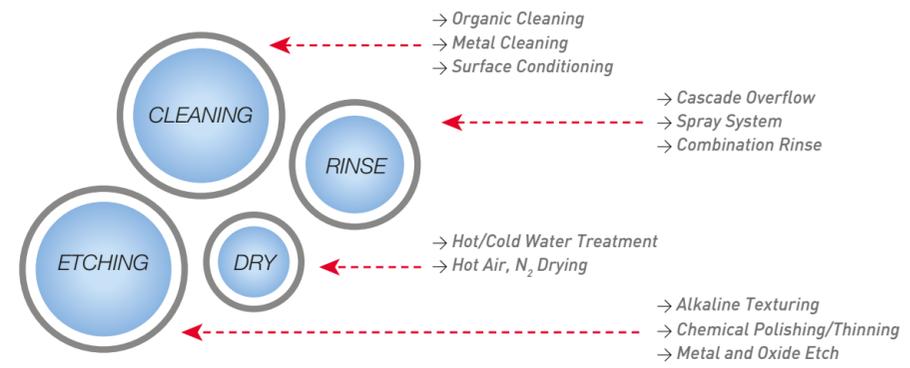
SILEX III

Modular, Automated Wet Processing System for Batch Cleaning and Etching for Solar Cells

SINGULUS TECHNOLOGIES provides complete automated dry-in/dry-out solutions for wet-chemical treatments of Si-wafers in standard and high-efficiency cell lines. The 2021 introduced modular SILEX III batch system offers a wide range of process options. With respect to highest flexibility in configuration, the SILEX III machine is characterized by a clear modular design and a compact footprint. The SILEX III machine concept fulfills current and future requirements of capacity, flexibility and reliability for mass production.

The SILEX III was specially designed for larger production volumes. With this mass production system, which can archive up to 750 MW annual capacity, all wet chemical applications (batch) at the PERC, TOPCon and HJT cell concepts can be covered. The SILEX III system achieves an output starting from 6,000 up to 14,000 wph (gross).

Common and Advanced Process Applications



SILEX III

Batch Wet Processing Equipment

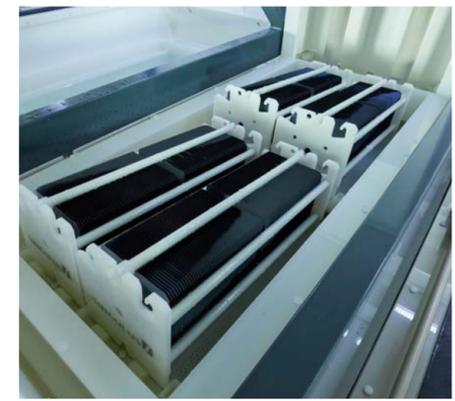
SILEX III Batch Wet Processing Equipment

The **SILEX III ALTEX** machine is designed to apply IPA-free texturing processes, offering substantial cost advantages compared to traditional etching systems. This texturing process can be adjusted to the individual requirements of standard and advanced cell technologies.

The **SILEX III CLEANTEX** combines common etching and cleaning steps of monocrystalline Si with advanced cleaning and conditioning processes. Efficient cleaning steps are an indispensable requirement to improve cell efficiencies and reduce operation costs. Ozone-based cleaning operations, applied on SILEX III wet bench, combine efficient organic and metal removal with an appropriate surface conditioning. Due to low chemical costs and consumption, simple process control and high metal removal efficiency, ozonized cleaning baths are the perfect substitute for traditional, expensive multi-step RCA cleanings, known from the solar and semiconductor industry.

The **SILEX III CLEAN** is provided to run dedicated cleaning sequences for pre- or post-deposition processes. Depending on cell process flow and requirement the configuration can be designed individually, involving RCA or Ozone based cleanings as well as slight etching steps.

- TYPICAL FEATURES**
- » High throughput 6,000-14,000 wph gross; M1-M12
 - » High uptime
 - » Low breakage rate
 - » Ozone-enhanced cleaning & etching
 - » Short and stable IPA-free texturing process
 - » Appropriate and effective rinsing and drying
 - » Individual, flexible process sequencing
 - » Onboard scheduler software for throughput tuning
 - » Onboard performance analyzer software



SILEX III Technical Data

Application	Etching and cleaning of solar wafers	
Throughput	Up to 14,000 (M6)	
Processes	Pre-clean SDE/texture Cleaning Rinse Drying	Alkaline, acidic Alkaline (CellTex®) Alkaline, acidic DIW overflow rinse Hot Air, Hot N ₂
Wafer	Size Thickness	M1-M12 <120 µm post process
Facilities	Liquid media Gases Exhaust Electrical power	DI water, chemicals Compressed air, N ₂ , O ₂ 400 VAC
Options	DI water heater Chiller Extended load/unload buffer Chemical supply systems Waste water pump stations SINGULUS process carrier (100 wafers) Ozone system	