

SINGULUS 

LINEX

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Inline Wet Process
Equipment for Treatment of
High Efficiency Solar Cells

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Inline Wet Process Equipment for Treatment of High Efficiency Solar Cells like PERC, TOPCon and Laser Doped Selective Emitter

PV Technology Powers the World

SINGULUS TECHNOLOGIES provides technology solutions for both crystalline and thin-film high-performance solar cell platforms. SINGULUS TECHNOLOGIES is an established equipment supplier with customers producing crystalline and CIGS/CdTe solar cells as well as future formats. Evolutionary improvement in cell concepts like PERC – TOPCon – LDSE PERC will drive the future of crystalline solar. SINGULUS TECHNOLOGIES' expertise includes wet chemical processes, physical-enhanced chemical vapor deposition (PECVD, physical vapour deposition (PVD), evaporation), surface engineering and thermal processing.

Future Cell Concepts: TOPCon Solar Cells

Tunnel oxide passivated contacts (TOPCon Solar Cells) are based on an ultrathin tunnel oxide capped by a doped Si film exhibiting excellent passivation and contact properties. This cell design has so far resulted in efficiencies of up to 25.7 %. SINGULUS TECHNOLOGIES provides for the production of TOPCon high performance solar cells the important manufacturing steps: inline wet processing and vacuum deposition (PVD & PECVD).



Inline Wet Process Equipment for Cleaning, Alkaline & Acidic Etching, Single Side Treatment, Polish Etch & PSG Removal & Inline Ozone Applications

SINGULUS TECHNOLOGIES is continuously developing the inline machine platform LINEX due to new market requirements. The increase in environmental standards leads to new demands on the generally known wet-chemical edge isolation process, which is usually implemented with nitric acid and hydrofluoric acid.

With the LINEX inline wet processing system, SINGULUS TECHNOLOGIES presents a tool for a NO_x-free, alkaline etching process, which, depending on hardware configuration, can reproduce a single-side process or even an immersion process with excellent etch performance. For LD SE PERC solar cells, for example, a single-side, alkaline etching step is required to ensure the efficient electrical insulation. The PSG layer, which can also be used as a protective layer for standard PERC cells in the alkaline immersion

process, is partially damaged by the laser treatment and can no longer protect the emitter sufficiently from attack by the etching medium.

If solar cells are manufactured with passivated contacts, the LINEX can map the complete process flow required for alkaline chemical edge isolation, BSG removal, the application of a wet chemical tunnel oxide and removal of Poly-Si wrap-around from PECVD/ LPCVD/ APCVD. The alkaline edge isolation process offers process relevant advantages, such as a smoother wafer backside, as well as OPEX savings due to lower chemical costs and less effort for wastewater treatment. Additionally, various adjustments and simplifications of the hardware have led to a cost down of the investment costs, which makes the LINEX even more attractive as a high-throughput production machine.



LINEX

Inline Wet Process
Equipment

LINEX Applications for High Efficiency Cell Concepts*

Poly-Si Removal:

Single side removal of Poly-Si wrap-around for TopCon applications

WetTO Application:

Tunnel-oxide formation for TOPCon applications

Alkaline Chemical Edge Isolation:

Electrical isolation for TOPCon, PERC, LD SE PERC

Alkaline Texture:

Ultra-short process time, superior aesthetics

Ozone:

Advanced cleaning technology

Controlled – Precise – Intelligent

- Fully automated inline wet process equipment with integrated process control
- Compact process modules with innovative media and process management
- Simple and robust wafer transport system
- Fully automated airflow control flaps for optimal process conditions available
- Virtual wafer tracking on each lane
- Inline wafer thickness measurement and reflectivity measurement on request

Safe – Clean – User Friendly

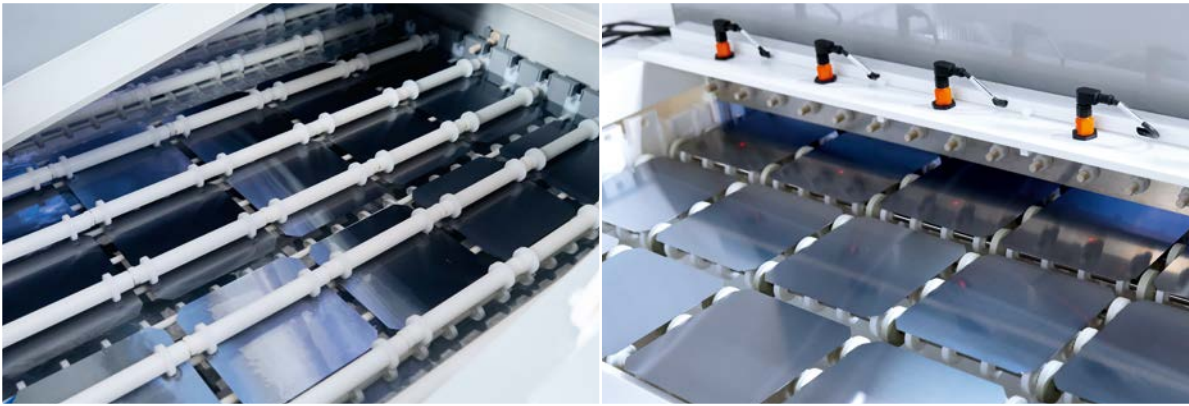
- Safe for operators, environment and for reliable processing
- Cleanroom compatible design according to ISO standards
- UL, SEMI and other standards on request
- Gentle wafer transport through the process media
- Excellent accessibility of the process modules from all sides

Typical Performance Characteristics

- Inline from R&D tool to the fully integrated 10 lane system
- Alkaline process up to 90 °C possible in 5 or 10 lane systems
- Single side Alkaline etch up to 5 µm
- NO_x-free edge isolation
- Integration of ozone for oxidation and cleaning sequences, up to 50 ppm per bath achievable
- Uniform and consistent media flow on wafer surface from lane to lane
- Easy integration of new or additional process options
- High uptime up to 99 %
- Low cost of ownership
- Low breakage rate down to 0.01 %
- Best footprint, up to 40 % footprint savings in comparison to competitor equipment
- High flexibility in wafer/substrate dimensions
- Wafer size change possible within 10 min
- Wafer thickness from 80 µm up to 210 µm possible
- Temperature range for drying from room temperature up to 60°C



* Other applications also available



LINEX
Technical Data

LINEX	5 Lane (M0 – M6)	10 Lane (M0 – M6)
Throughput	up to 5,300 wph	up to 10,600 wph
LINEX	4 Lane (M8 – M12)	8 Lane (M8 – M12)
Throughput	up to 4,100 wph	up to 8,200 wph
Velocity	3.3 m/min	3.3 m/min





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THIN FILM
DEPOSITION



SURFACE
ENGINEERING



THERMAL
PROCESSING



WET
CHEMICAL

SINGULUS TECHNOLOGIES – Innovations for New Technologies

SINGULUS TECHNOLOGIES develops and assembles innovative machines and systems for efficient and resource-saving production processes, which are used worldwide in the solar, semiconductor, medical technology, consumer goods and data storage.

The company's core competencies include various processes of coating technology, surface treatment and wet-chemical and thermal production processes.