

TENUIS II

Wet Process Equipment
for Economic Processing
of CdS/Alternative Buffer
Layer for CIS/CIGS/CIGSSe
Solar Cells

TENUIS II

Modular System for Chemical Buffer Layer Deposition CIGS & CdTe Thin-Film Solar Cells

SINGULUS TECHNOLOGIES is the market leader for chemical buffer layer deposition for CIS/CIGS thin-film solar cells. With the development of a completely new concept for the TENUIS II system, SINGULUS TECHNOLOGIES will open up the way to cost-effective production. This machine is a central component for the manufacturing of CIS/CIGS thin-film solar cells.

The industrial manufacturing machines of the TENUIS type have a modular cluster system and enable both significant savings in terms of required floor space and the simultaneous one-sided coating of two substrates.

The TENUIS II also provides advantages upon commissioning and in the ramp-up stage. Because of the new cluster design, the commissioning can commence modularly after a short installation time and the first substrates can be coated. The following cluster can be assembled simultaneously or consecutively. Correspondingly, the TENUIS II meets the ever increasing demands of the market with respect to the reduction of the commissioning and ramp-up times.





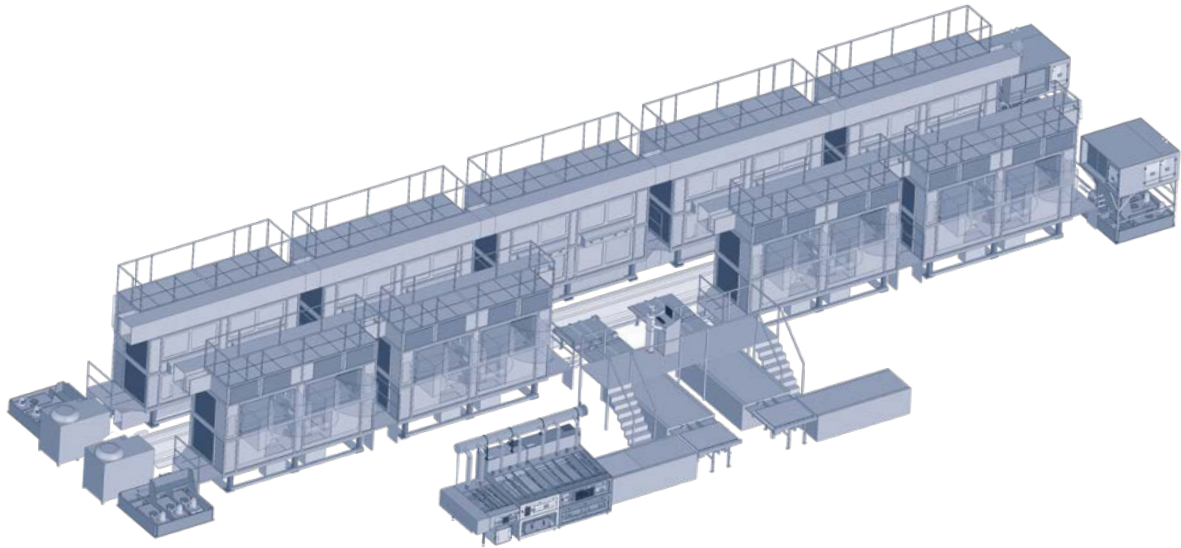
Main Characteristics

- Standard reference process:
highest efficiencies and low risk
- More than 150 process modules in
production (world leader)
- Minimized chemical consumption
- Fully automated inline system
- Single side deposition incl. protection
against backside contamination
- Modular system (easy upgrade for
higher throughput)
- Reproducible process results
- Automatic dosage and mixing system
- Deposition systems for cadmium-free
buffer layers

The new generation of the TENUIS plant offers substantial cost advantages in the production of high performance CIS/CIGS thin-film solar cells. With application and temperature control, the process time has been reduced, bringing the positive effect of significantly higher production line output.

The new system makes it possible to use alternative buffer layer by replacing the intermediate layer system consisting of cadmium sulfide and zinc oxide by a combination of zinc oxide sulfide and zinc magnesium.

Due to new and unique concepts in terms of dosing and temperature control, the developers at SINGULUS were successful in reducing the process time by up to 30 %, resulting in a considerably higher output in production. Furthermore, the costs are significantly reduced by temperature profiles adjusted to the process and by very efficient use of process chemicals, so that the new system consistently exploits the savings potential in the manufacturing of thin-film solar cells.



Enabler in the CIS/CIGS Thin-Film Solar Cells Industry

The new generation of the TENUIS plant offers substantial cost advantages in the production of high performance CIS/CIGS thin-film solar cells. Furthermore, the costs are significantly reduced by process adjusted temperatures and by the very efficient use of process chemicals, enabling the new plant to consistently exploit the savings potential in the manufacturing of thin-film solar cells. SINGULUS TECHNOLOGIES offers wet processing systems from R & D, through pilot use, to full production range 80, 150 and 300 MW.

For a higher throughput, several production machines can be combined to a large production complex.

Through its production systems, SINGULUS TECHNOLOGIES supplies wet-chemical processing and selenization systems for second-generation CIGS/CIS cells and has thus positioned itself at the vanguard of technology leaders for pioneering development and production systems. In-line sputtering systems add a further production stage to the portfolio, which already spans the key processes of CIGS/CIS cell production. In light of the anticipated volume of investment in production lines for CIGS/CIS thin-film solar cells, SINGULUS TECHNOLOGIES believes the long-term prospects of the solar segment to be bright. Through its new system concepts and innovative processes, the company is promoting the development of solar technology, which will play an increasingly important role in the global energy mix.





Manual Experimental Setup for Process Evaluation and R&D

- Substrate size for foil and glass: 300 x 300 mm² up to 500 x 600 mm²
- Manual loading
- High performance heating by fluid technology
- Automatic 3D-axis wobbling (movement)
- Manual dosing
- Process transfer to production line 1:1 possible
- Accessory like fume hood and automatic dosing modus possible

Semi-automated Experimental Setup for Process Evaluation

- Substrate size for foil and glass: 600 x 900 mm² up to 1600 x 1200 mm²
- Manual loading
- Automatic heating
- Automatic 3D-axis wobbling (movement)
- Automatic dosage

Fully-automated Experimental Setup for a Semi Commercial Line

- Substrate size for foil and glass: 600 x 900 mm² up to 1600 x 1200 mm²
- Automatic loading
- Automatic heating
- Automatic 3D-axis wobbling (movement)
- Automatic dosage
- Chemical supply and mixing systems





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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.