Technology and market leader Meyer Burger uses a new modular drive system for wire sawing silicon wafers and achieves the highest possible cut speeds with ever thinner cutting wires. The Siemens safety concept integrated into the drive systems provides for the necessary safety.

“Wired” for Safety

Wire saws are the first choice for cutting silicon ingots into ultrathin wafers for the photovoltaic and semiconductor industries. The technology and global market leader in this field is Meyer Burger AG, based in Thun in Switzerland. The company’s wire saws meet users’ demands for high quality, minimal cut losses, and maximum process reliability. The companies in the industry are constantly working on designing the wafers and wires to be thinner and thinner so that cut losses can be minimized. Thinner wires, however, require highly precise control. Meyer Burger thus prefers to rely on control and drive technology from Siemens for its wire saws in order to secure and further expand its technological leadership position.

Avoiding wire breaks

The principle of a wire saw for silicon wafers is comparable to that of an egg slicer. The wire is wound over two wire guide rollers driven in a master/slave coupling so that a wire field is created. The wire, which is several hundred kilometers long, is transported at a speed of up to 20 m/s by a winder and an unwinder, each of which has its own dancer regulator to ensure constant wire tension. The saw load of up to 1,000-mm-long silicon blocks is lowered from above onto the wire field at the appropriate feed rate, allowing ultrathin wafers to be cut. It is not the wire itself that provides the cutting effect, but instead a continuously fed abrasive fluid of silicon carbide/diamond powder and glycol, making up what is known as slurry. The focus is on avoiding wire breaks, which in most cases lead to the complete destruction of the increasingly expensive base material.
Safe shutdown of drives guaranteed

For this demanding task, Meyer Burger relies on the compact Sinamics S120 drive system. Thanks to its modular structure, it is scalable in terms of both performance and functionality and can be used flexibly. A very compact multi-axis system was implemented with active line modules (ALMs) for supply and several motor modules for the main, winder, and transfer axles. The two winders are driven by compact water-cooled asynchronous motors, and the axles for the transfer equipment and dancers are driven by highly dynamic Simotics S-1FK7 servomotors. A Simotics S-1FT7 provides for highly precise workpiece advancement, even at extremely low speeds. The entire drive intelligence is found in the CU320 control unit, enabling centralized drive diagnostics. The control unit is connected with the other components of the drive system through the Drive-Cliq digital system bus.

For safety technology, Meyer Burger relies on the Safety Integrated concept from Siemens. The heart of the safety solution for the wire-sawing machine is a fail-safe Simatic S7-300F control. The safety functions are realized by means of ASiSafe. The DP/AS-i F-Link serves as the master for the ASiSafe system and as the coupler between the two fail-safe bus systems, Profisafe and ASiSafe. The wire-sawing machines are manufactured as separate modules and then assembled into a complete machine. Thanks to the flexibility of ASiSafe, the individual components can be easily linked via a two-wire line in final assembly and can be combined to create a complete safety function unit. A Sinamics S120 frequency converter with integrated safety functions provides for the safe shutdown of the drives. For the wire-sawing machine, the STO (Safe Torque Off) function is used. The control reduces communication and relieves the overlying PLC.

Automation from a single source

The overlying Simatic WinAC PLC runs on a PC and communicates via Profibus with the distributed Simatic ET 200S Compact peripheral subassemblies and the Sinamics S120 drive system, and via Gateway with an AS-i bus system. “The end-to-end use of automation technology from a single source is advantageous in many ways for a globally operating machine manufacturer,” says Alexander Beck, head of sales and marketing at Meyer Burger Wafertec. “We like to make use of the expertise and support of Siemens’ worldwide service network, and our customers appreciate the availability of spare parts around the globe whenever a fast delivery is required.”

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