

■ DMG America Inc.

Ultra-Small

Chip equipment supplier machines glass ceramic composites with tolerances of less than ten micrometers using Sinumerik control.

The most technically sophisticated industry in the world today is arguably the semiconductor industry. Semiconductor, or 'silicon chip', manufacturers create components with dimensions down to 45 nanometers. This is about half a wavelength of visible light. The equipment required to manufacture these components has to work to astonishing levels of accuracy and is itself built from super high-specification parts. ASML, one of the world's leading suppliers of semiconductor manufacturing equipment, uses ultrasonic machine tools controlled by the Sinumerik 840D CNC to produce super high specification components for its machines.

Photo-lithography

Photo-lithography semiconductor integrated circuits are made by coating a 'wafer', a thin disk of pure silicon with a photographic emulsion, called 'photoresist' and then projecting on the wafer the minute patterns for the circuit. The exposed photoresist, which now contains the circuit pattern, creates a mask for selective etching and chemical deposition processes. After these processes are complete, a new layer of photoresist is applied on top and the process is repeated, over 20 times. The many different layers interconnect to create the complete integrated circuit. This process is known as photo-lithography.

ASML, based in Veldhoven, The Netherlands, supplies the world's top semiconductor OEMs with

Sinumerik 840D CNC with its open architecture allows easy programming and set-up for either ultrasonic or conventional milling work



advanced wafer stepping and scanning equipment for their chip lithography processes. A new ASML technology, Twinscan, images one wafer while simultaneously measuring the next one to achieve near perfect alignment of the successive layers.

Many of the components used by ASML in the Netherlands are produced by the ASML Optics group in Richmond, California. The most critical parts are made from extremely expensive raw materials, one being Zerodur, a glass ceramic composite. ASML manufactures components from Zerodur to consistently uniform tolerances of less than 10 microns using ultrasonic machining equipment. Significant improvements in shopfloor productivity came recently through the use of new ultrasonic machining equipment supplied by DMG America with Sinumerik 840D.

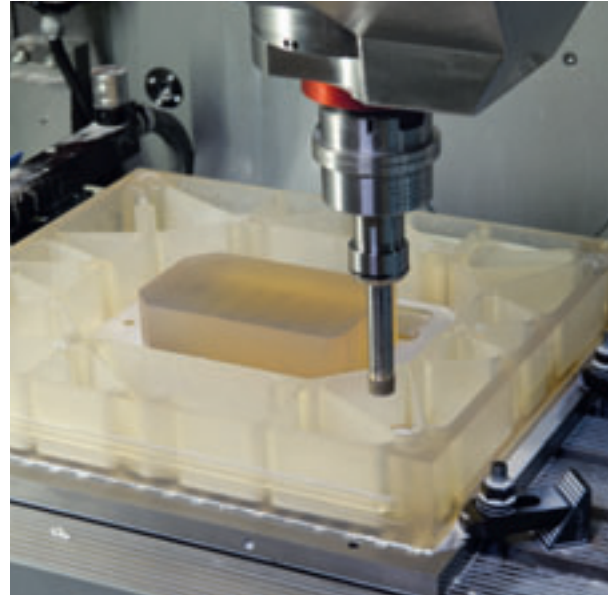
New hard to work materials

ASML has many years experience in machining glass materials, but the more difficult to work new glass ceramic composites called for a new approach. It was necessary to move quickly from prototyping to production without sacrificing the extremely tight tolerances required. ASML found a solution with the Ultrasonic 50 and Ultrasonic 70, two machines in the DMG series that offered the flexibility for three-axis and five-axis machining, in both ultrasonic and conventional milling machine modes. These machine tools use the Sinumerik 840D CNC with the capability for quick programming and set-up in either machining mode. In the ultrasonic mode, the Adaptive Control and Acoustic Control features of the CNC combine with its open architecture design to effectively monitor the machining action and quickly adjust the feed and spindle speeds to maintain predictable accuracies to the desired levels of this demanding customer environment. Adaptive Control monitors the process forces on the machine tool, while the Acoustic Control registers the intensity of the tool vibration on the workpiece surface via an electrical echo signal, as well as the status of the coolant pressure.

The HMI was developed in cooperation between Siemens and DMG. Set-up of all parameters is done seamlessly in windows within the standard Siemens CNC screen array including the customized Adaptive and Acoustic Control programs. The concept of open architecture on the Sinumerik 840D enables the machine builder to program its own functionality into the NC kernel, providing the customer with more flexibility in set-up strategies, faster cycle and reaction times.

No need to watch

Since the machining process is continuously monitored, unattended machining is possible, even in the high-precision, small batch runs. As an example, intelligent control algorithms typically regulate the



Zerodur block during the ultrasonic glass machining process

feed rate while machining an inside radius. Usually, process force increases, even if the other parameters remain static, owing to the high angle of content. The Sinumerik control recognizes these contours and automatically adjusts the feed rate to maintain correct cutting conditions. Also, with the touch of one button, an ASML operator can call up the ultrasonic generator screen and all variables can be quickly adjusted, including ultrasonic frequency, amplitude and output, or the operator can automatically adjust the output for a defined number of tools in the automatic tool changer (ATC).

In programming its ultrasonic machines, ASML utilizes one unique feature of Sinumerik 840D, namely, the Swivel Cycle, part of the ShopMill software suite. This enables the operator to set-up the origin of the part and the Swivel Cycle allows for rotational shift of the coordinate system, XYZ transitional, with no separate work offsets needed. A significant time saving results because an operation that previously required four set-ups over three machines can now be performed with two set-ups on one chuck on one DMG machine.

Matthew White, Optics Manufacturing Manager at ASML notes, "We continue to find new and better ways to use the DMG Ultrasonic machines for the improvement of our overall process here at ASML. These machines have simply ramped up our productivity by a factor of five, compared to the previous technology we utilized". ■

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