

With **Mask Blanks** into the Champions League

Schott Lithotec has further extended its leading position as a supplier of key components for microlithography with its Advanced Quality Line (AQL).

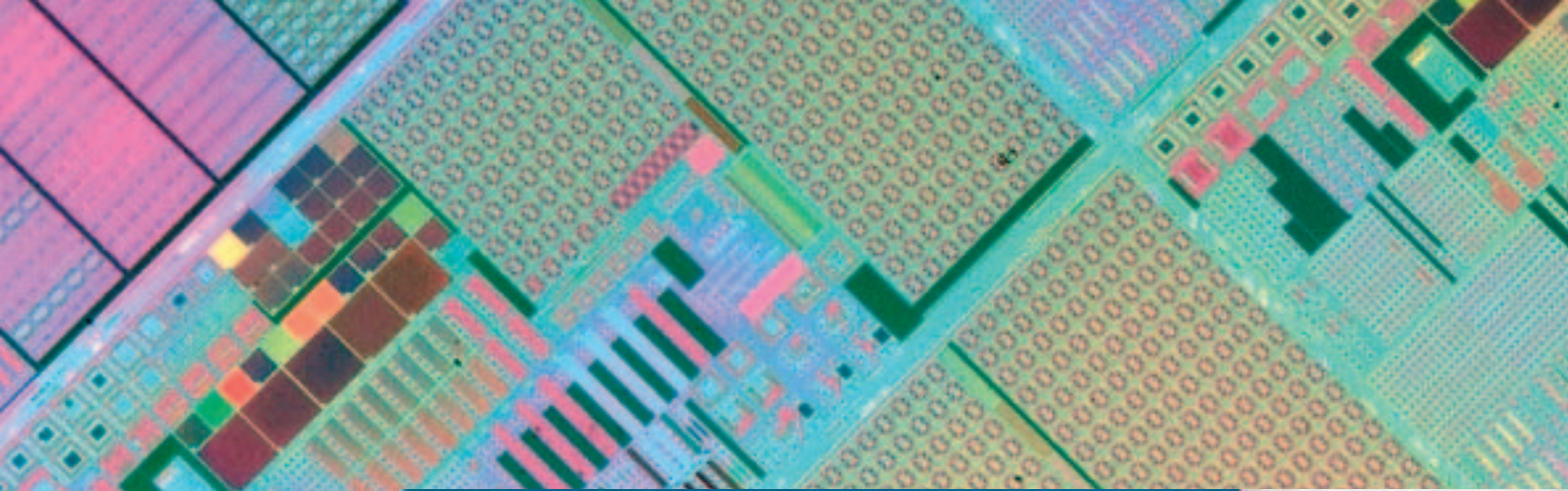
► When computers were in their infancy, circuits were still designed on the drawing board. This method is now of course totally outmoded, for a microchip with only half a million switching elements would require a sheet of paper as big as a tennis court – on the other hand there are a billion transistors on the most powerful chips nowadays (gigabit chip). The techniques required to get the chip layout onto the silicon wafer are correspondingly complicated and costly. This most important stage in chip manufacture, photolithography, can be compared with projecting a slide. The structures of what will become the chips are completely exposed step by step in what is known as the wafer stepper. With wafer scanners on the other hand the mask is scanned with every exposure process. For this the wafer table and mask are continuously processed in opposite directions.

Mask blanks “Made in Germany”

Materials with particular optical properties play an outstanding role in the chip manufacturing process. Schott Lithotec AG, which has its main base in Jena, has taken over the world’s leading position in the growth of calcium fluoride monocrystals for the 157-nm lithography of the future. In addition the company is active in the components field at its Meiningen (Thuringia) facility. “We supply mask blanks as a high-tech product used as the basis for mask manufacture”, explains Dr. Peter Rudakoff, Manager of Schott Lithotec AG’s Components Business Group in Meiningen. The mask blanks consist of high-purity fused silica substrates coated with a very thin layer of chromium and a photoresist. The mask manufacturers structure the mask blanks by exposing and etching them to produce the masks required. These masks



Schott Lithotec works on the ultramodern production of mask blanks under clean room conditions like in the chip industry. A chromium coating is applied to fused silica substrates, which are then coated with photoresist.



Coated mask blanks are the basis for photomasks used in wafer steppers for the manufacture of semiconductor chips.



are then used as the pattern for "exposure" of the silicon wafers.

The "mask blanks" are products of the highest quality that have to comply with the extreme requirements of the chip industry. To date this lucrative business has been dominated almost exclusively by manufacturers from the Far East. There is currently only one supplier worldwide for the highest qualities. It is no wonder, therefore, that purchasers are urgently waiting for new suppliers. "With the setting up of our Advanced Quality Line, known as AQL for short, we want to enter the champions league of mask blank suppliers and at the same time create the pre-requisites for supplying larger quantities on a continuous basis," says Components Business Unit's sales manager Dr. Schneider-Störmann.

The 16,000 square meter premises, where at one time Robotron manufactured electronic components, instruments and

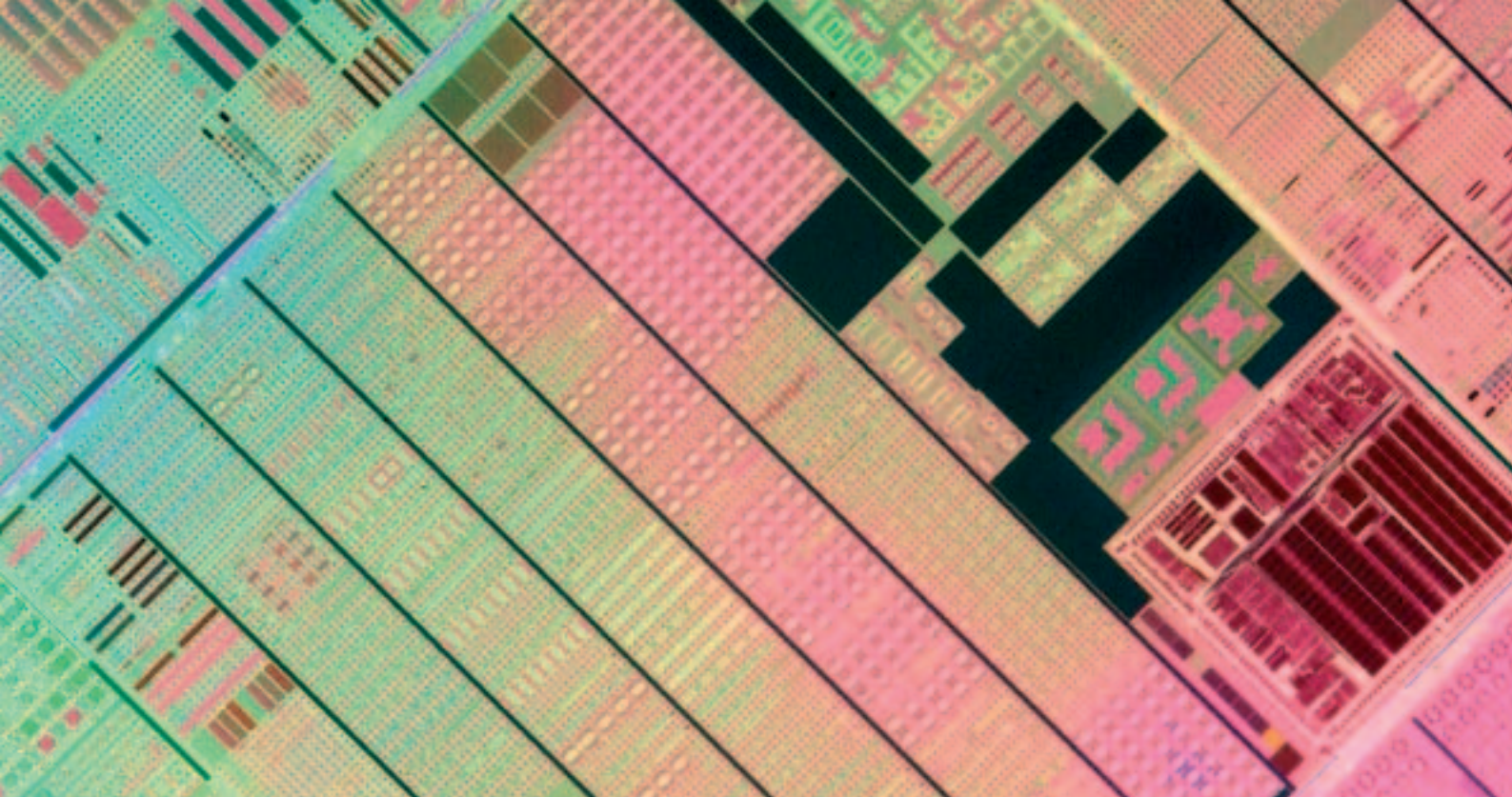
hard disks, are ideal. There is also a pool of specialist labor that speaks for the location. As with chip production itself, the manufacture of materials and components make the highest demands on cleanliness. This means that appropriate care has to be taken, says production manager Michael Dietz, not only with clothing regulations, but also over the technical equipment, which, for example, ensures that there is permanent positive pressure and looks after the air quality in the clean rooms. At Schott Lithothec microclimate boxes are being used to further minimize the particle level.

Top-level infrastructure

Fused silica substrates for mask blanks are also manufactured at Meiningen. Here too the very highest quality standards have to be maintained. The circular or square

cross-section ingots are first cut with a wire rope saw into panels between one and nine millimeters thick and then the edges are worked. A particularly important stage is the lapping and polishing which follows and produces an extremely smooth surface. The final roughness is in the ångström and thus the atomic range. Only a few of the tiniest particles may remain on the substrate. Looking for particles on a 6" substrate with the laser scanner, a special development for Schott Lithothec, is like looking for a tennis ball on the 540 square meter surface of Lake Constance in Southern Germany.

The chromium coating sputtering unit, which operates on the ion beam principle, is an absolutely state-of-the-art facility. Previously this method, which is also known as IBD (ion Beam Deposition), was only used in the renowned Lawrence Livermore



View of an eight-inch wafer.

National Laboratory (Livermore, USA), which is operated jointly by the University of California and the US Department of Energy.

The photoresist coating facility also complies with the highest standards. The photoresist is like an undeveloped film onto which the chip pattern is projected. Other important elements include various work places for measuring systems that can carry out, for example, the accuracy of measurement down to 0.1 micrometers using laser scanners – an essential component of quality control. After each individual operating process widely varying parameters such as geometry, flatness, roughness and optical parameters are checked. It is no wonder, therefore, that the facility is certified to DIN 150 9001.

In addition to substrates and mask blanks, calcium fluoride items supplied by Schott Lithotec AG's crystal growth facilities in Jena are also processed in Meiningen. The product range also includes what are known as fused silica wafers for applications in genetic engineering (gene blanks), in ophthalmology and industry (telecommunications, automotive).

With investments to a value of 20 million plus subsidies from the EU, the German government and the state of Thuringia, Schott Lithotec in Meiningen has a manufacturing facility of world stature. Following its successful entry into the standard class, it is now in a position to make the leap up to the top level. "We see great opportunities for entry into this difficult business and it is our aim to become the first or second supplier to the mask producers worldwide," says Dr. Martin Heming, Schott Lithotec AG's Chief Executive Officer, making clear his plans for the future. Thanks to our intensive cooperation with the Schott Group's research center in Mainz, and with the backing of a strong research network of customers, academic institutions and institutes, the prospects of making this a reality are good.

Well ahead on the "roadmap"

In spite of the difficult economic situation worldwide, and its impact on the computer and semiconductor industries, technological development is continuing to push ahead. For example, work is already in progress on the implementation of 157-nm lithography,

which is set to come into use in about 2004 and should make 70 nanometer chip structures possible (1 nanometer is one millionth of a millimeter). The next generation, extreme ultraviolet (EUV) technology, is also already in preparation and could become reality from 2008 onwards. These steps are following a timetable which US companies first drew up in 1991 and according to chip structures, should be reduced in size by 30 percent every three years. All the processes required are coordinated with this objective. Driven on by global competition, the manufacturers have surpassed their own guidelines. Over the past 10 years, miniaturization has occurred on the average of two-year intervals. In other words, the chip generation changed in this period. ◀