Bianca Freudenberger
Schott Glas
Mainz, Germany

GOOD CONNECTION

In microsystems technology, complex electronic and mechanical structures are brought together in a very tiny space. Special glasses from Schott are also used in this future-oriented technology: as stabilizers and insulators.

Microelectronics and silicon technology form the basis of microsystems technology. Microchips are supplemented by sensors, that provide them with impressions of the environment, and actuators, that enable them to have an effect on the environment.

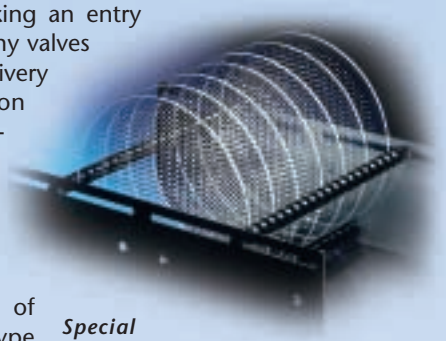
Microsystems are far more powerful than processors, which depend on electronic processes alone and up until now switched only the flow of electrons through tiny wires. By taking advantage of mechanical, optical, chemical, biochemical or other processes, micromechanical appliances connect microelectronics and the physical world. Movement, sound, heat and physical forces can be measured and controlled.

Micro-Electro-Mechanical-Systems (MEMS) are getting smaller and smaller. Tiny electronic, mechanical and optical modules are brought together at a distance of a few millimeters on a silicon chip to create intelligent sensors or actuators that are invisible to the human eye.

There is a wide range of applications for these microscopically small "machines". They are used as switches, pumps and sensors in airbags, seatbelt tensioners and printer heads. In the future they could also be making an entry into medicine as tiny valves controlling the delivery of vital medication into the blood-stream.

Glass micro-components

The manufacture of MEMS of this type also involves glass components, which are used as stabilizers and insulators. High demands on quality are made regarding the surface finish of these glass substrates. They must be flat, parallel and free from defects according to stringent specifications. These are requirements which can be met by alkali-free AF 45 and low alkali D263 T borosilicate glass from Schott Displayglas.



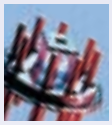
Special glasses provide an insulating and stabilizing function in microtechnology.

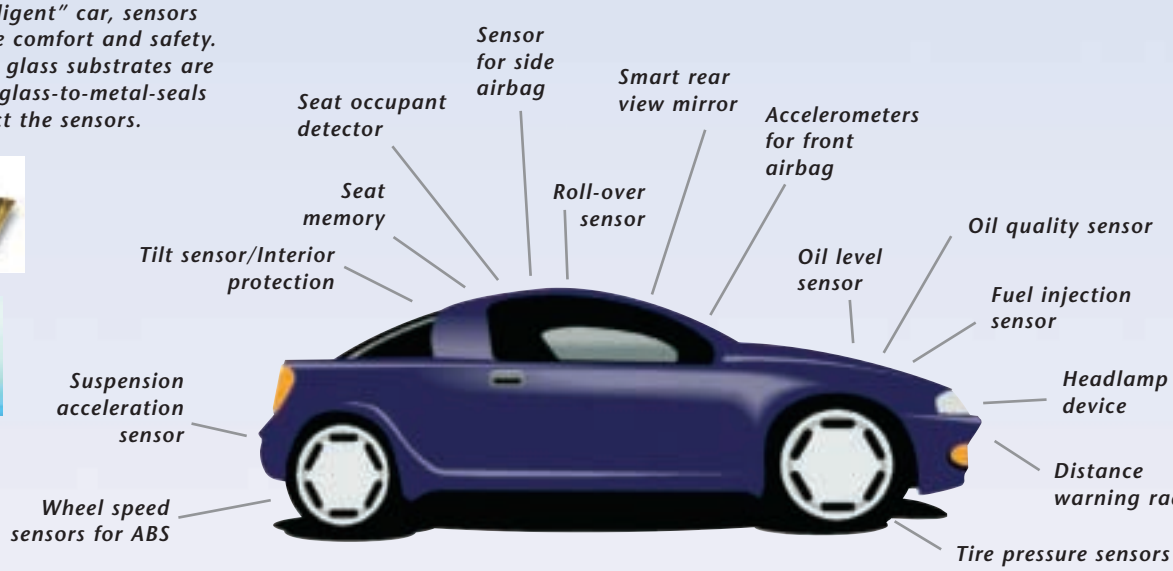
For acceleration sensors in airbag systems, reliability and efficiency are decisive criteria. In an emergency, they must work reliably in fractions of a second even after years in service. Conversely, of course, there must be no chance of them detonating prematurely. Special glasses such as "Borofloat" with their extreme resistance to chemical, thermal and mechanical influences and their electrical insulation properties are ideal substrate materials for this type of application.

Microtechnology under extreme conditions

Integrated silicon pressure sensors are particularly suitable for use in harsh environments, such as the measurement of suction pressure in combustion engines. In the manufacture of these, a silicon wafer containing a number of sensor elements is located on a glass plate, which provides insulation and stabilization. A process known as anodic bonding is used to firmly bond the two materials to each other by ion exchange. Since they now react as a unit, the material must behave virtually identically when subjected to temperature fluctuations. In such cases "Borofloat" 33 special glass made by Schott Jenaer Glas GmbH is used since

In the "intelligent" car, sensors provide more comfort and safety. High quality glass substrates are used in tiny glass-to-metal-seals which protect the sensors.

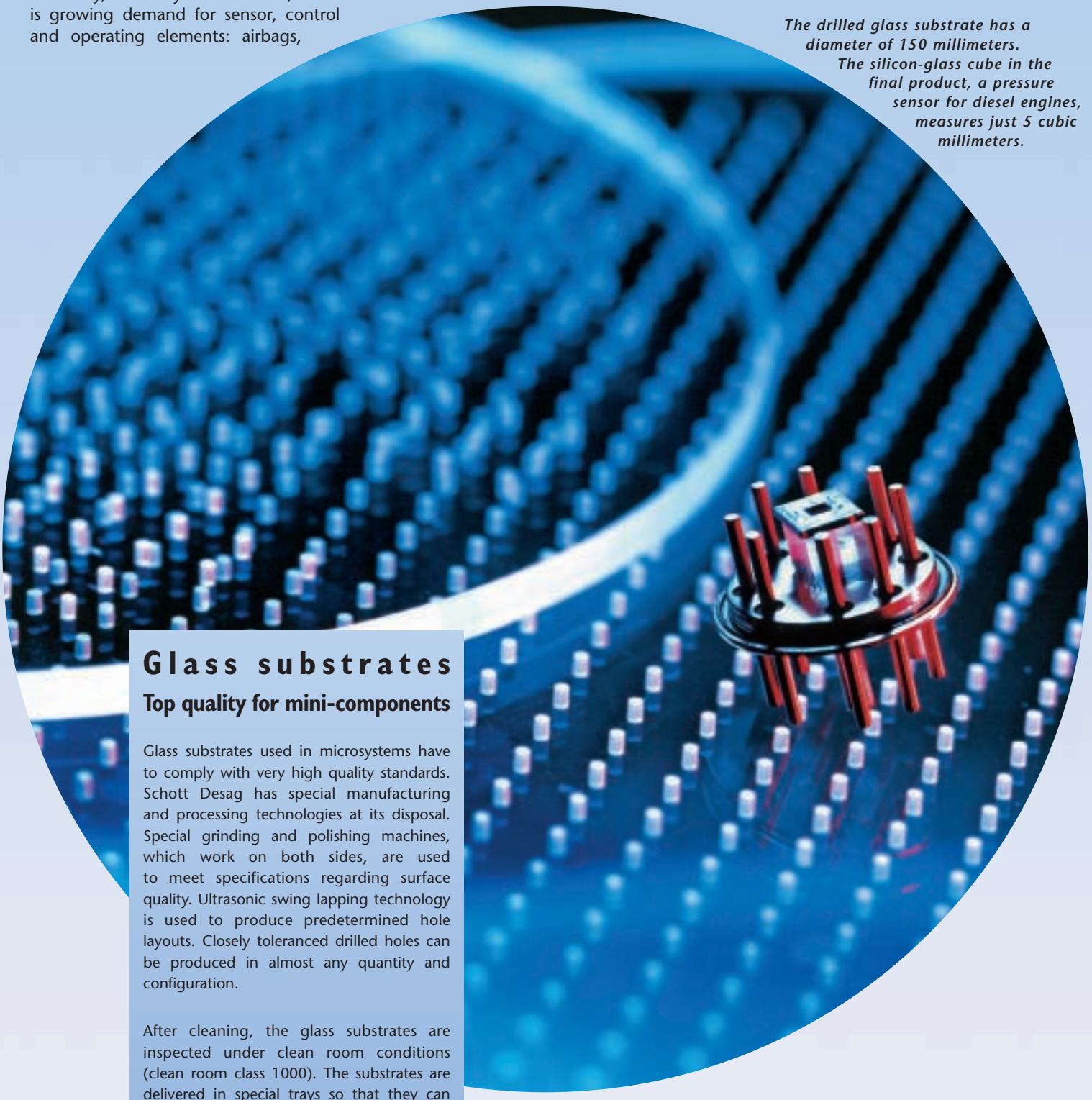




its thermal expansion is virtually the same as that of the silica.

The manufacture of cars is just one such application in which microsystems will play an important role in the future. With the ever-increasing requirements for safety, reliability and comfort, there is growing demand for sensor, control and operating elements: airbags, electronic seat adjustment, air-conditioning and digital road maps with satellite positioning all require a wide variety of electronic, mechanical and optical components.

Miniature machines are also gaining ground in biology – for example in biosensorics – and medicine and they will play a crucial role with future developments ■



The drilled glass substrate has a diameter of 150 millimeters. The silicon-glass cube in the final product, a pressure sensor for diesel engines, measures just 5 cubic millimeters.

Glass substrates

Top quality for mini-components

Glass substrates used in microsystems have to comply with very high quality standards. Schott Desag has special manufacturing and processing technologies at its disposal. Special grinding and polishing machines, which work on both sides, are used to meet specifications regarding surface quality. Ultrasonic swing lapping technology is used to produce predetermined hole layouts. Closely toleranced drilled holes can be produced in almost any quantity and configuration.

After cleaning, the glass substrates are inspected under clean room conditions (clean room class 1000). The substrates are delivered in special trays so that they can be used without further delay in customers' production facilities.