

tech | buzz

ELECTRONIC PACKAGING



SCHOTT
glass made of ideas

Issue 2 | January 2010

Hermetic Protection for Automotive Sensors

Only glass-to-metal packaging can offer the reliable long-term protection that automotive sensors require

December 2009 – Sensors and air-bag detonators inside an automobile are subjected to heat and aggressive chemicals, but must remain hermetically sealed and cannot be allowed to malfunction. Zero error tolerance applies for these components inside an automobile. Despite advances in the encapsulation of sensitive electronics based on plastics, seals made of glass with feedthroughs made of metal are unbeatable in terms of remaining sealed and in their durability.

Modern cars are full of sensors, control devices and electric motors. In a worse case scenario whereby a component fails to function, it can tie up a motor vehicle's entire "nerve system". Therefore, it should be of no surprise that, according to statistics from Germany's ADAC, electronic failures – with an upward trend from a share of more than a third – is the leading cause of breakdowns. For this reason, car manufacturers are rightfully demanding zero errors in the electronic components they receive from their suppliers, even over the entire lifetime of a vehicle.



A glass-to-metal sealed feedthrough for a humidity sensor

The numerous sensors in a car – a luxury class car contains more than a hundred of them – function by converting a physical value into an electric measurement signal. In order to do so, the sensor housing needs to be in contact with the outside world and yet remain hermetically sealed off from destructive influences. For instance, the sensor inside the transmission is concurrently subjected to hot oil and severe vibrations; air pressure sensors that are directly vulcanized into the rubber of the tires are also placed under considerable stress. How this is achieved at a critical point determines whether or not a sensor can stand up to heat and chemicals for many years.

Only recently, an attempt has been made to seal off the sensors with plastics, like polymers and epoxide. While these new materials are relatively resistant to shifts in temperature and insen-

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sitive to special types of oil, the question of how these materials will actually behave over an automobile's long life cannot yet be answered. Long-term tests are mainly based on laboratory data. In addition, plastic becomes increasingly hard when subjected to high temperatures and turn brittle, forming cracks and allowing for humidity and oil to penetrate. Here, epoxides that are hardened using organic acid anhydrides have brought fewer advances than one had hoped. In addition, when these sensors come into simultaneous contact with materials that expand differently in response to temperature changes or are subjected to mixtures of water and oil or water and glycol, the chemical structure of the epoxide suffers.

This is where glass-to-metal seals differ: they have proven themselves already for decades. SCHOTT Electronic Packaging has been manufacturing glass-to-metal housings since the 1940s. They encapsulate tiny opto-electronic components, sensitive detonators for airbags and electrical feedthroughs in power plants as well as liquefied gas tanks in a vacuum-tight manner.

Glass-to-metal seals defy severe heat and icy cold, as well as aggressive chemicals. This makes them the products of first choice, particularly for safety-relevant applications, such as aerospace and automotive engineering.

Glass-to-metal feedthroughs have small sintered specialized technical glasses which isolate the pins and housings from each other. Both the material and the manufacturing process are chosen

in such a way that the materials selected for use in the metal base exert pressure onto the glass and the pins while they are cooling off, as a result of the different coefficients of thermal expansion. This is referred to as compression glass-to-metal sealing.

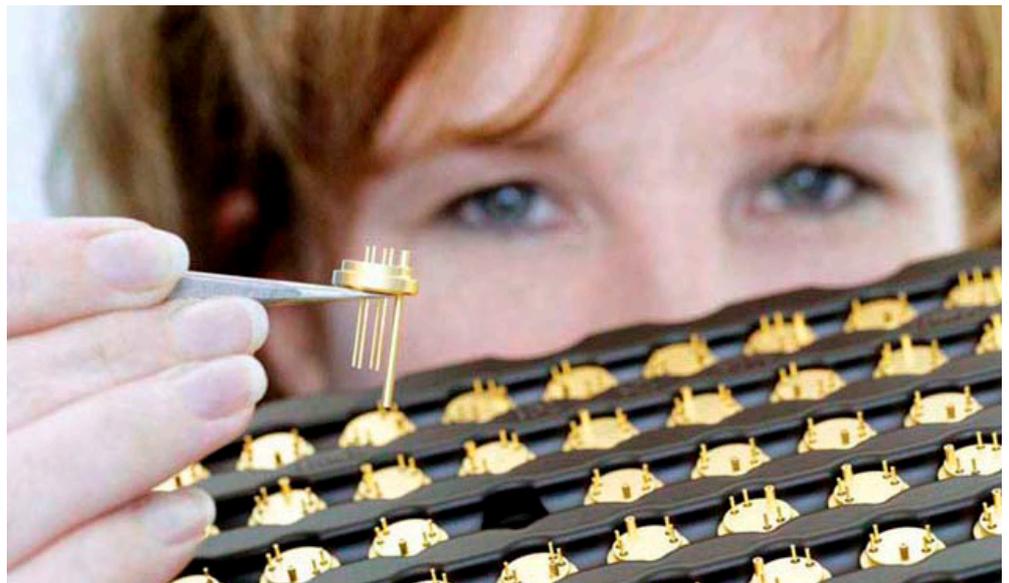
Glass-to-metal feedthroughs can withstand severe temperatures. At SCHOTT, the behavior of the materials during severe shifts in temperature, mechanical stress or following exposure to chemical substances has been known for decades. Special designs with select types of metals have proven themselves with temperatures of -270°C to $+450^{\circ}\text{C}$. For not yet installed glass-to-metal feedthroughs, SCHOTT performs type testing to review the thermal endurance and reaction to rapid temperature changes since the thermal expansion and resulting forces inside the housing can change after it has been installed. SCHOTT's experts are, therefore, always able to advise customers on the right glass-to-metal combination for their demands and the proper installation method.

Tedious test runs are no longer necessary and the investments in tools and

machines are minimal, due to the use of standardized housing shapes and sizes. The bases and caps can be welded or soldered together within seconds by the customer and no pre- or post-treatment is necessary. Epoxides, on the other hand, are injected in and need to be hardened by being warmed up inside an oven or with infrared lamps. This takes time and complicates manufacturing.

SCHOTT plants that manufacture automotive components ensure a reject rate of zero ppm and the components are certified according to the strict TS16949 standard. Random tests (helium test with mass spectrometer) are constantly conducted on samples to ensure that the maximum leakage rate for all its glass-to-metal packaging is at 10^{-8} millibar* liters per second. Neither plastic, nor epoxide housings can achieve the low leakage rates of glass-to-metal packaging.

Despite the advances that have been achieved with polymers, the combination of glass and metal for sealing off detonators and sensors in automobiles is still far superior to epoxide approaches.



Transistor Outline (TO-8) headers with glass-to-metal sealed feedthroughs provide the basis for hermetic encapsulations of pressure sensors as used in industrial metrology and instrumentation.

Glass Ceramics for Efficient Fuel Cells

SCHOTT offers key components for SOFC – the environmentally-friendly form of power generation

October 2009 – Committed to the development of “green technologies”, SCHOTT has developed extremely heat-resistant glass and glass ceramics as long-lasting sealing materials for high temperature fuel cells. With an operating temperature of between 650°C and 850°C, Solid Oxide Fuel Cell (SOFC) produces electricity and heat in a very efficient way. They are used worldwide in small power stations, domestic power supplies and as an auxiliary power generator for vehicles.

Our atmosphere continues to heat up due to the high levels of CO₂ emissions – a result from the burning of fossil fuels. According to the International Economic Platform for Renewable Energies (Wirtschaftsforum Regenerative Energien - IWR), despite the prices of fossil fuels rocketing to new heights, the global output of the greenhouse gas between 1990 and 2008 rose by nearly 40 percent. The key to sustainable and environmentally-friendly growth lies in energy efficiency. The fuel cell, and in particular the SOFC thereby represents a promising solution.

Hydrogen is the source of energy for the fuel cell. The gas however only occurs on earth in a chemically bound form, which means it requires renewable or fossil sources of energy to attain it. Currently there is no infrastructure for the comprehensive supply of hydrogen, but SOFC is able to internally reform fossil fuels such as natural gas, biogas, fuel oil or diesel directly into usable energy. An important competitive advantage therefore exists for this technology.

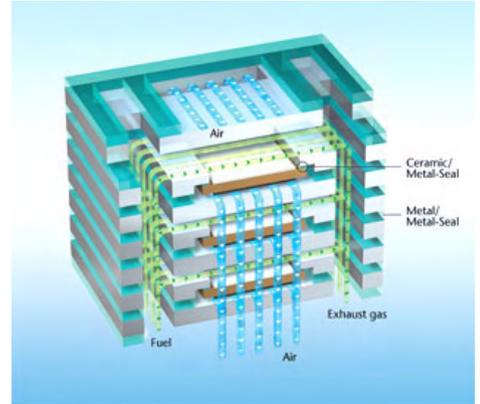
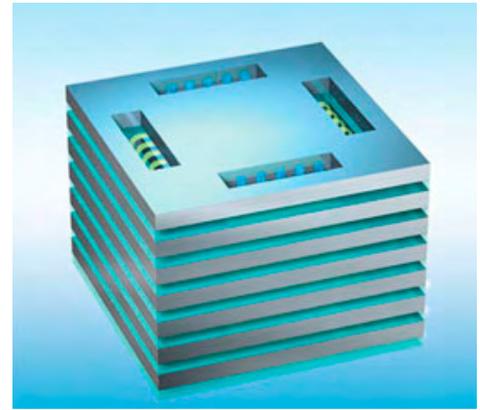
Fast retrofitting in industry and households is possible

SOFC can be attached directly to the connections for fossil fuels, which are already present in the industry as well as in approximately half of all households in Germany and in many countries around the world. Natural gas is particularly well-suited as an energy supplier. The gas consists to a large extent of methane, which consists of one carbon and four hydrogen atoms, therefore offering a very favorable hydrocarbon relationship and thus a high energy output.

The greatest potential for SOFC technology in the future is therefore the efficient supply of the energy requirements of the industrial, commercial and domestic sectors in an environmentally-friendly manner. The galvanic cell converts approximately 80 percent of the chemical energy into usable electricity and heat. Its advantages lie in the fuel flexibility, high efficiency and the extremely low CO₂ emissions. The main waste product of the fuel cell is water.

The high temperature fuel cell is “ripe for the mass market”

“The infrastructure exists and also technologically the SOFC is to a large extent ready for the mass-market”, explains Claire Buckwar, Director of Marketing at SCHOTT Electronic Packaging, the leading manufacturer of powders from glass and glass ceramics for the hermetic encapsulation and passivation of electro-technical components. “The manufacturers of high temperature fuel cells now need suitable industrial



partners which fulfill the highest international quality standards and offer high security of supply.”

SCHOTT has developed special glass and glass-ceramic seals with physical and chemical characteristics which are optimized with respect to the high operating temperatures of the SOFC of between 650°C and 850°C. The coefficients of thermal expansion are coordinated with those of the cell and interconnector materials. In this way stresses are reduced with the cooling of the hermetically sealed glass-to-metal connections. In addition, the seals possess a defined crystal phase in order to increase the thermal stability of the seals.

Hermetically sealed even at the highest temperatures

“The high operating temperatures of the Solid Oxide Fuel Cell creates a demanding environment and hence, the materials used for this product must be carefully selected”, according to Dr. Jörn Besinger,

Director of Research and Development at SCHOTT in Landshut (Germany). "In order to ensure that the cell can produce energy efficiently over the long-term, the gas channels at the anode and the cathode as well as at the interconnectors of the fuel cell stacks must be hermetically sealed and partly insulated electrically."

In many aspects fuel cells function like batteries with a continuous fuel supply. Today's high temperature fuel

cells usually consist of flat galvanic cells, which are stacked together in order to obtain a higher energy performance. The layout of the fuel and air supply elements on the macroscopic and microscopic scales as well as the sealing and connection technology of the stack components with glass-ceramic soldering represents a basic requirement in order to ensure optimal efficiency of the cells over long periods.

Information on TO Caps for UV Applications – New Product Information

TO Caps for UV Applications

Product Information

SCHOTT offers a wide variety of TO caps with sealed-in lenses or windows. These caps are sealed hermetically by fusing the glass directly to the metal frame without the use of any other interface materials. This is achieved by reheating coated glass and then fusing it with the metal. TO caps can be manufactured with various, various glass and ceramic lenses or window types of films for special applications. Windows and lenses can also be supplied in a range of shapes and according to customer specifications.

TO caps for UV applications are manufactured to achieve maximum UV stability for the customer. In addition, a borosilicate glass, which has been specially designed for use in such applications, offers optimal stability. The excellent accuracy of sizes will have no influence on the performance of the caps.

Advantages

- Economies of alternative for
 - Quartz and sapphire applications, e.g. for filters and general photo protection
 - Integrated sensor principle (e.g. low resistance sensor)
 - High chemical stability
 - Good UV transparency for UV A & UV B

Applications

- Medical applications e.g.:
 - Phototherapy treatment
 - Dental applications
 - Fluoroscopy and ultraviolet visible spectroscopy
 - Gas chromatography detectors
- Industrial applications e.g.:
 - Photo catalytic coating of film, coatings and adhesives
 - Paper coloring and document validation

Available Coatings:

- Metal Pate
- Electroless Nickel
- Gold (Au) sputter
- Sputter Anti-reflective Coating

Technical Information

Cap height: 1.0 to 10 mm ± 0.1
 Temperature stability: -100 °C
 Chemical resistance: High
 Humidity proof stability: 85 °C to 100 °C for 10 cycles
 Transmission (overall spectrum): 99% (uncoated), 95% ± 1%

Additional: Process hermeticity for:

- SOI
- Plasma desiccation (20 % to 100 %)
- Steam desiccation (20 % to 100 % to 1 atm.)

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October 2009 - SCHOTT offers a wide variety of TO caps with sealed-in lenses or windows for the use in many medical as well as industrial applications. These caps are sealed hermetically by fusing the glass directly to the metal frame without the use of any other interface materials. Besides being an economical alternative for quartz and sapphire applications as well as integrated sensor principles, the TO caps also offer high chemical stability as well as good UV transparency for UV A & UV B.

TO caps can be manufactured with windows, convex (plano and biconvex) lenses or various types of filters. Windows and lenses can also be supplied in a variety of designs and according to customer specifications.

EP Website Now Available in 5 Languages

November 2009 – SCHOTT's Electronic Packaging (EP) business has launched its website in Chinese, Japanese, Korean and Russian to offer to customers, comprehensive product and company information in their native language. In addition, the company also updated its English website with an improved user interface as well as information about EP's new products.

As a materials and components supplier, it is sometimes not easy to identify the end-product or application that EP supplies into. With the new navigation by applications, visitors can easily identify the right products they require based on their

applications or even make surprising inferences from reference applications. "SCHOTT EP supplies to a wide variety of applications and works closely with our customers to provide innovative solutions for today's product needs, as well as that of the future. Hence, we maintain a forward-looking technology roadmap and are constantly adding new products to our extensive product portfolio", said Hermann Ditz, Executive Vice President, SCHOTT Electronic Packaging (EP) business unit.

Addressing the latest trends and developments in the world of medical electronics and green technology, for instance, SCHOTT EP has added new

products to its portfolio, including hermetic housings for autoclavable electronics as well as glass and glass-ceramic sealants for solid oxide fuel cells. The update also includes comprehensive information about the new products available at SCHOTT EP with the acquisition of SCHOTT Elecpac, LLC since April 2009. With updated product information available in English, Chinese, Korean, Japanese, and Russian, visitors can easily obtain comprehensive information at their convenience.

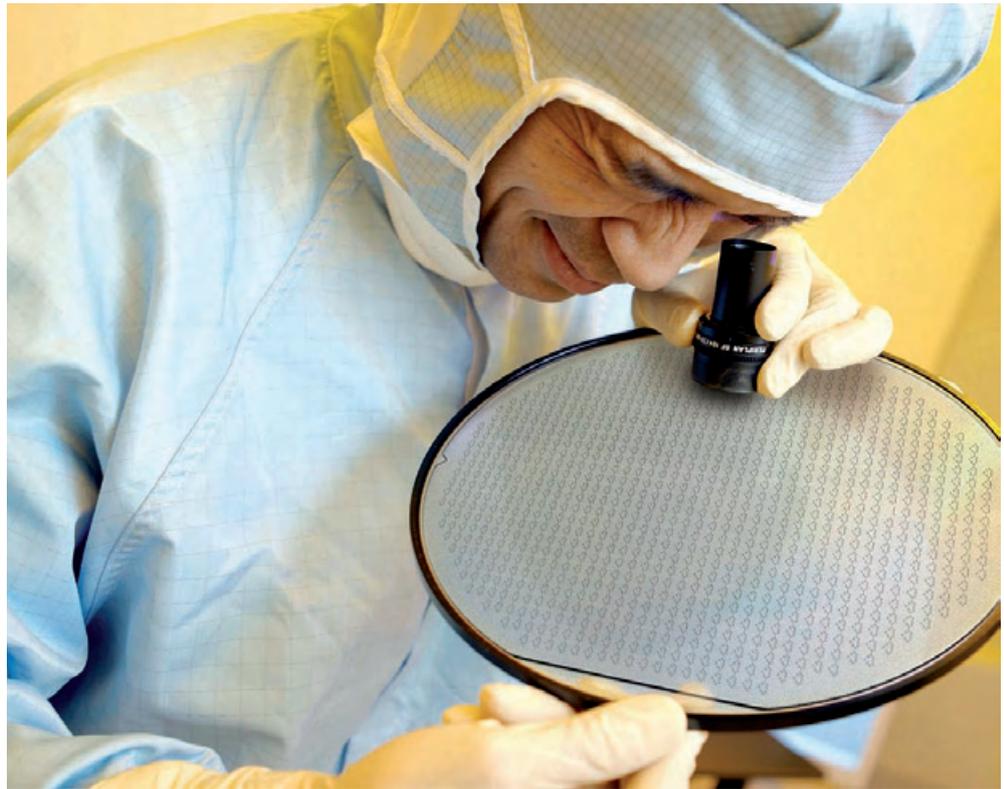
MEMS Tightly Sealed with SCHOTT HermeS™

NEC SCHOTT Components Corporation is developing a new 8" high via density wafer that features hermetically sealed electric feedthroughs for micro-electro-mechanical systems and is intending to launch this product in 2010

July 2009 – Micro-electro-mechanical systems or MEMS, for short, are finding their way into more and more applications. They are being used as acceleration, pressure and gyro sensors in automobiles, to switch on light in telecommunications networks with the help of tiny mirrors or to eject ink from printing heads.

Many other applications could also benefit from MEMS; however the difficulties involved in packaging these tiny helpers have prevented them from being put to widespread use in mass markets. The problem is that sensitive electronic and mechanical components must be hermetically sealed and protected against environmental influences and yet, at the same time, electric signals need to be able to enter and exit them. SCHOTT HermeS™, a new technology for manufacturing glass substrates that contain embedded metal feedthroughs, developed by NEC SCHOTT Components Corporation (NSC) – part of SCHOTT's Electronic Packaging business group and a global leader in glass-to-metal seals for electronic applications – is capable of meeting both of these demands.

Instead of relying on complicated sealing solutions in which the connecting wires run through a sealing ring and occasionally cause leaks, NSC is now using a completely new approach called HermeS™ (derived from "hermetic seal") in which the connector vias are baked into glass. These



Dr. Hidefumi Yamamoto examines SCHOTT HermeS™, a high via density wafer that features hermetically sealed electric feedthroughs for micro-electro-mechanical systems.

are then joined together with the contacts of the MEMS on the silicon wafer that is the same size using a soldering or pressure technique. In this way, glass-to-metal feedthroughs can be manufactured using a one-step process and then be connected with hundreds of MEMS during a second step – an ideal prerequisite for cost-effective mass production.

Due to the fact that the complete lengths of the metal feedthroughs used in HermeS™ are melted inside glass and do not run through sealing rings that are prone to leaking, the MEMS in HermeS™ are hermetically sealed much more tightly than with any other approach. During tests with helium, the leakage rate was less than 10^{-9} pa•m³/sec – this is true even over decades, as SCHOTT Electronic Packaging has been able to prove for over 50 years with other glass-to-metal feedthroughs. HermeS™ also

achieves peak values with respect to electric insulation, but also with its low dielectric constant. Borofloat® 33, which has the same thermal expansion as silicon from room temperature to over 300°C, is used as the glass substrate. Even when subjected to severe heat, for instance, inside the engine compartment of an automobile, no cracks occur between the glass substrate and the MEMS.

HermeS™ is currently available as 4-inch and 6-inch wafers. The metal vias made of tungsten can be 100 micrometers in thickness, but must be kept at least 250 micrometers apart from each other. Correspondingly, thicker vias require more space. The positioning accuracy is approximately ± 50 micrometers. Theoretically, this allows for substrates with several 10,000s of metal feedthroughs.

Starting from 2010, NSC plans to offer 8-inch wafers as well. With even smaller via diameters and pitch distances, these wafers are most appropriate for high volume industrial applications especially in the field of sensors and optical devices. For the customers, it means that such wafers can enable a high level of integration and miniaturization of the MEMS packaging designs while maintaining the same su-

perior hermeticity performance and electrical properties. In addition, as glass is transparent, HermeS™ also offers entirely new possibilities with respect to quality control. For instance, even after it has been packaged, visual inspections can be performed on the MEMS or it can be adjusted using laser light. This wouldn't be possible with metal housings.

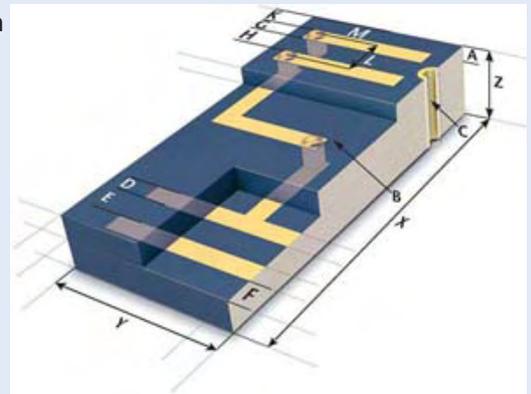
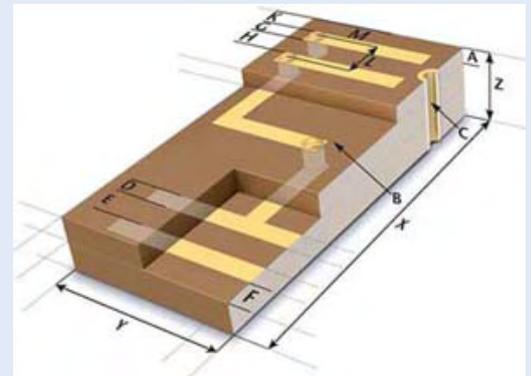
SCHOTT HTCC and LTCC Design Rules – New Product Information

June 2009 - The boom in opto-electronics and the trend towards ever higher data transmission rates has led to increased demands on electronic devices as well as its electronic packaging solutions. Opto-electronic devices and modules are expected to provide superior performance and a long lifetime. This means that the packaging has to correspondingly offer a high degree of functionality as well as complete protection against exposure to harmful gases and environmental influences. Here, electronic packaging solutions including SCHOTT's multilayer ceramics (H/LTCC, High/Low Temperature Cofired Ceramic) can present significant advantages.

SCHOTT H/LTCC high frequency feedthroughs enable fast data transmission rates of more than 40 gigabits/second. In addition, the electrical layout of these ceramic feedthroughs is widely variable,

three dimensional and provides coplanar interfaces. Complex and customized packaging solutions which also include optical and thermal interfaces, especially for – but not restricted to – fiber optic applications, can be integrated using sophisticated soldering processes with glass or metal solder.

To find out more about SCHOTT's HTCC and LTCC design rules, please refer to the new information sheets "Design rule for Low Temperature Cofired Ceramics (LTCC) substrate" and "Design rule for High Temperature Cofired Ceramics (HTCC) substrate" available on SCHOTT CerTMS® technology page. Alternatively, you could also contact us directly at any of our competence centers near you.



SCHOTT Elecpac, LLC receives International Aerospace Quality Standard Certification with a Perfect Score

SCHOTT is well poised to deliver high quality products to the civil and military aviation and aerospace market

May 2009 - SCHOTT Elecpac, LLC officially received certification by successfully passing the intensive auditing process developed in co-operation with and for the members of the aerospace industry. This new standard of the International Aerospace Quality Groups (I.A.Q.G.) builds on the well-known ISO 9001:2000 standard with additional requirements necessary to respond to the unique regulatory, safety, quality and reliability requirements of the aviation and space sector. SCHOTT Elecpac's qualification scores can be reviewed on the Online Aerospace Supplier Information System (OASIS).

"This international certification and the listing on the OASIS database for certified aerospace suppliers mark a milestone for SCHOTT Elecpac, LLC.

As part of the aerospace industry supply chain, quality is critical and our products are now officially approved to reliably meet industry requirements", explains Ron Campbell, President and General Manager of SCHOTT Elecpac, LLC.

In April, SCHOTT North America, Inc. announced the acquisition of Elecpac, a division of Wilbrecht Electronics, Inc. The division was renamed SCHOTT Elecpac, LLC and has since become a wholly owned subsidiary of SCHOTT North America, Inc.

As part of SCHOTT's Electronic Packaging business unit, SCHOTT Elecpac is a leading global manufacturer of electronic packaging components. The company works in close partnership with its customers and uses a wide spectrum of engineering disciplines including electrical, mechanical and chemical engineering to bring the product of the most value to their partners.

SCHOTT's Electronic Packaging business unit has been developing and supplying hermetic packages and feedthroughs for more than 60 years and is a leading manufacturer of housings and other components for the reliable, long-term protection for sensitive electronics. Its core technologies are glass-to-metal and ceramic-to-metal sealing and thermal sensing components, as well as a variety of cutting edge specialty glass competences. The business unit has five production sites and a number of competence centers in several countries in Europe, Asia, and the USA, serving customers in the Aerospace, Avionics, Ordnance, Defense, Medical and Commercial industries.

Information on Technical Glass Powders – New Product Information

June 2009 - Based on more than one hundred standard glass types as well as different dry and wet grinding methods including patented technologies, SCHOTT is able to supply a wide variety of glass powder products.

SCHOTT provides excellent purity, a consistently high quality level as well as a large assortment of standard and custom-made glass

formulations. We also offer lead-free solutions for all major applications.



For more information about SCHOTT's Technical Glass Powders as well as processing technologies, please refer to the new product information sheet "Technical Glass Powders".

Please contact us directly at any of our competence centers near you.