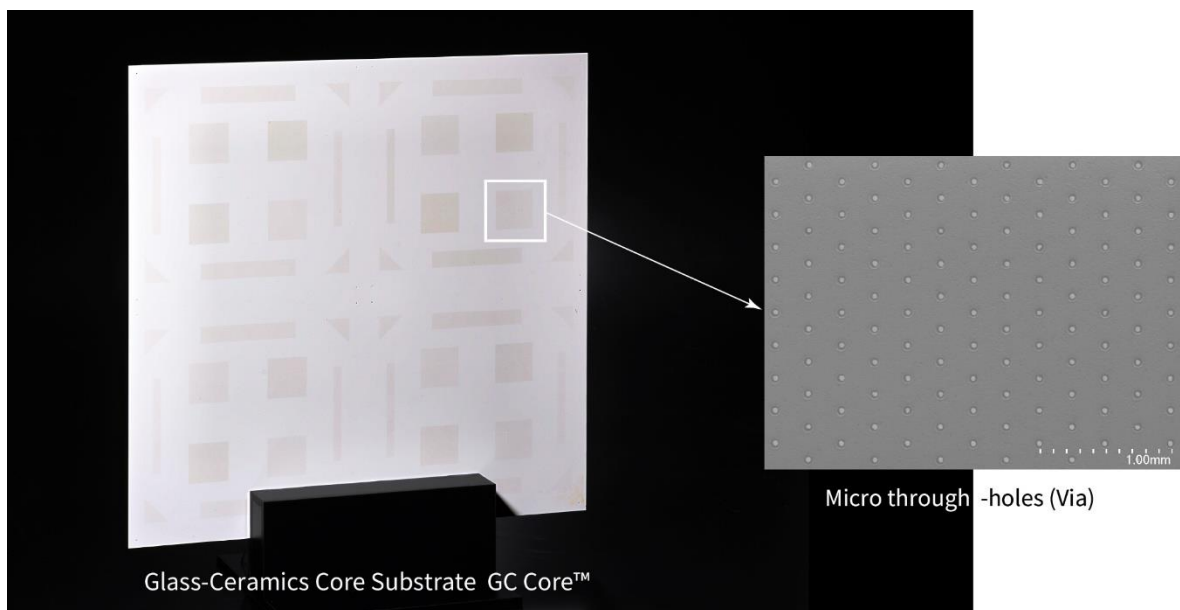


Development of GC Core™ - Glass-Ceramics Core Substrate for Next-Generation Semiconductor Packages

- High-speed, crack-free and economical micro through-hole (via) processing -

Nippon Electric Glass Co., Ltd. (Head Office: Otsu, Shiga, Japan; President: Akira Kishimoto; “NEG”) has developed a glass-ceramics core substrate (hereinafter referred to as the “GC Core™”), which has promising potential for use in next-generation semiconductor packages.



GC Core™ developed by NEG. Processed with a Via Mechanics laser processing machine.

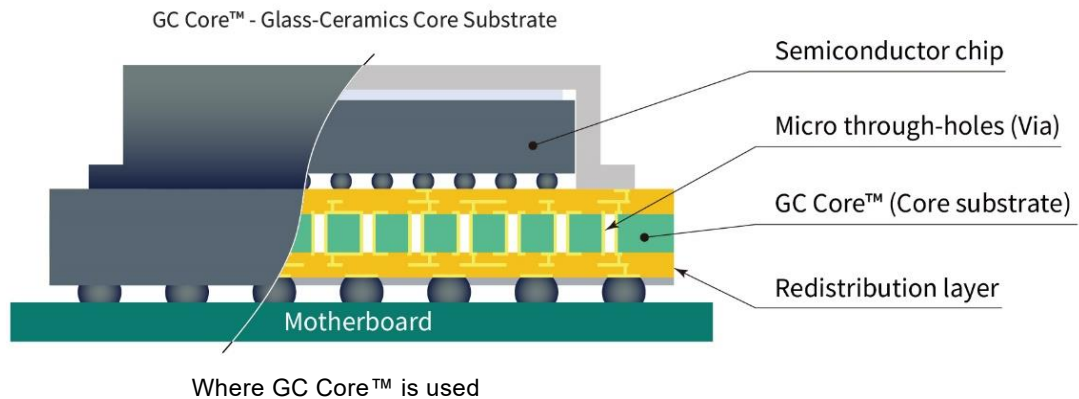
■ Development background

In recent years, with the growing demand for data centers and the increase in data traffic due to the spread of technologies such as generative artificial intelligence, there has been a demand for higher-performance and lower-power semiconductors used in the infrastructure that supports these technologies.

To improve the performance of semiconductors, it is essential to miniaturize circuits, develop chiplets, *1 and increase the size of substrates. However, conventional plastic core substrates*2 make it difficult to miniaturize circuits, and they also have rigidity issues, such as deformation when

mounting multiple semiconductor chips or making the substrate larger.

For this reason, progress is being made in developing core substrates made of glass, which has excellent electrical properties, rigidity, and flatness, as a next-generation material to replace plastic core substrates. The GC Core™ that NEG has recently developed is a core substrate made from a composite of glass powder and ceramic powder. In addition to the properties of a core substrate made of glass, the new material offers the advantage of being easy to machine when making micro through-holes.



■ Features of GC Core™ developed by Nippon Electric Glass

(1) Capable of being drilled with a CO₂ laser

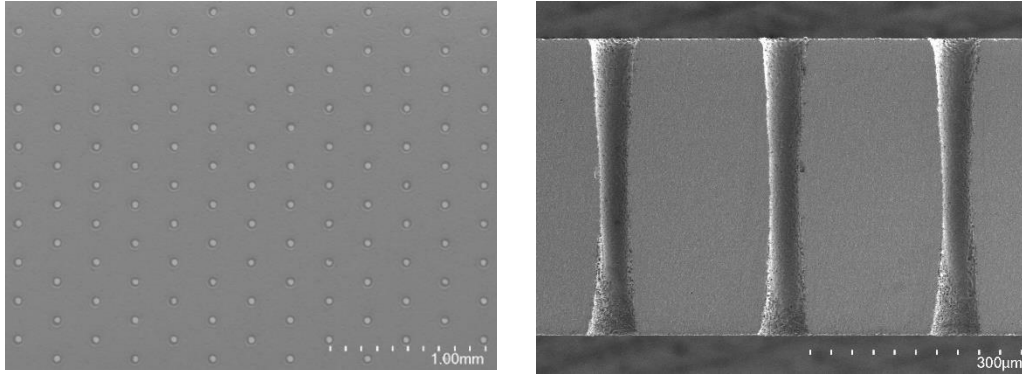
Micro through-holes need to be formed in the core substrate to electrically connect the fine metal wiring formed on the front and back sides.

High-speed & crack-free

When drilling holes in ordinary glass substrates with a CO₂ laser, a certain percentage of them will develop cracks, which can lead to breakage of the substrate. The GC Core™ has the properties of ceramics^{*3} as well, enabling high-speed, crack-free drilling.

Economical and expected to reduce mass production costs

When drilling holes in ordinary glass substrates, the most common method is to use laser modification and etching to create holes to avoid cracks, but this method is technically difficult and requires capital investment. The GC Core™ is economical because the holes can be made using a widely used CO₂ laser machines, and we are expected to reduce mass production costs.



Cross-section of micro through-holes in the newly developed GC Core™ (SEM image)

GCC-1 □300 × t 0.4mm, Holes: φ75 µm holes at a Processing rate: over 20,000 holes/min
 Processed with a Via Mechanics laser processing machine

(2) Low dielectric constant and loss tangent

The glass-ceramic material uses LTCC (low temperature co-fired ceramics), a material developed exclusively by NEG. This material has a low dielectric constant and loss tangent*4 and reduces signal delay and dielectric loss.

(3) Thin substrates available

The GC Core™ is stronger than glass substrates, allowing for thinner substrates, contributing to thinner semiconductors. In addition, because it is less likely to break, it offers improved ease of handling during the semiconductor package production process.

(4) Easily change specifications to meet customers' needs

The properties of the GC Core™ which depend on the composition and compounding ratio of glass and ceramics can be tailored to your needs. In addition to low-dielectric-constant types with excellent dielectric properties, we also offer high-expansion types that match the thermal expansion of plastic substrates and high-strength types, making it possible to develop substrates that can be used for a wide range of applications.

| Type | | Low dielectric constant | High CTE | High mechanical strength |
|--|---------|-------------------------|----------|--------------------------|
| Product code | | GCC-1 | GCC-2 | GCC-3 |
| Loss tangent | 2.45GHz | 0.0013 | 0.0002 | 0.0004 |
| | 40GHz | 0.0016 | 0.0004 | 0.0007 |
| Dielectric constant | 2.45GHz | 3.9 | 7.0 | 7.9 |
| | 40GHz | 3.8 | 6.8 | 7.6 |
| Thermal expansion coefficient (ppm/°C) | | 6.1 | 8.9 | 7.4 |
| Bending strength (MPa) | | 150 | 260 | 340 |

■ Future plans

We have now successfully developed a 300 mm square substrate. We are currently working on development with the aim of enlarging the substrate to 515 × 510 mm by the end of 2024. The 300 mm square substrate will be exhibited at the JPCA Show 2024 to be held at Tokyo Big Sight from June 12 to June 14, 2024.

Exhibition Title: JPCA Show 2024
Period: Wednesday, June 12 to Friday, June 14, 2024
Venue: Tokyo Big Sight East Exhibition Halls
Booth No.: 6H-01
Exhibition invitation ticket available free of charge at: <https://www.jpca-show.com/show2024/en/>

- *1. Chiplets: An advanced semiconductor packaging technology that densely mounts multiple semiconductor chips with different functions on a single substrate, improving processing speed.
- *2. Core substrate: The substrate material that serves as the base on which semiconductor chips are mounted.
- *3. Properties of ceramics: Ceramics have a crystalline structure. The atoms and ions within the crystal are strongly bonded together. Therefore, ceramics are relatively strong against external forces in terms of deformation and cracks.
- *4. Loss tangent: A measure of energy when a dielectric substance is polarized. The smaller the loss tangent, the lower the conversion of electromagnetic energy into heat, and as a result attenuation of signals is reduced.

【Company Profile】

Nippon Electric Glass Co., Ltd. is a world-class specialty glass manufacturer headquartered in Otsu City, Shiga Prefecture. Special glass that creates novel functionality is transformed into a variety of products such as sheets, tubes, threads, and powder, and is used in a wide range of fields, including semiconductors, displays, automobiles, electronic devices, medical care, and energy. The special glass developed using the technology and track record that we have honed over our 70-year history is highly regarded in a wide range of fields, from everyday life to cutting-edge industry.

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| Company name: | Nippon Electric Glass Co., Ltd. |
| Representative: | Akira Kishimoto, President |
| Head office location: | 7-1 Seiran 2-chome, Otsu, Shiga 520-8639, Japan |
| Founded: | December 1, 1949 |
| Business details: | Manufacture and sale of special glass products and fabrication and sale of glass manufacturing machinery |
| URL: | https://www.neg.co.jp/en |

(Contact regarding this release)

Nippon Electric Glass Co., Ltd. 7-1 Seiran 2-chome, Otsu, Shiga 520-8639, Japan
PR Office, Administrative Division Phone: +81-77-537-1702 (direct)