

The Development of KYOKA, the World's First Semiconductor Material Modification Machine —We've developed a machine that enables mass production of the semiconductor material modification process—

SHIGA, Japan - Nissin Ion Equipment Co., Ltd. (hereinafter referred to as Nissin Ion Equipment), which is one of the group companies of Nissin Electric Co., Ltd., has developed a new semiconductor material modification machine called KYOKA that is capable of mass production in the material modification process that plays a part in the manufacture of semiconductor devices.

KYOKA was designed by applying the company's high-current ion technology developed for smartphone display manufacturing—a market dominated by Nissin Ion Equipment—and is the world's first machine that satisfies all the various performance requirements for practical application and mass production of material modification, including high throughput and low processing cost. In April 2024, a demonstration machine will be installed at Nissin Ion Equipment's Shiga Plant to begin processing samples for customers.

This is a business activity that contributes to one of the six growth strategies in the Nissin Electric Group Medium-to-Long-Term Business Plan VISION2025, "Expansion of environmentally friendly products."

Our customers are eager to introduce new processes that will enable further advancements in the miniaturization of semiconductors, including artificial intelligence (AI) chips that are a hot topic of late and expected to make significant contributions to the future development of science and technology, as well as the lower power consumption and more advanced functionality that smaller-scale semiconductors will offer. One such process is the use of ions to modify materials. By using low-energy ion beams to irradiate the materials from which semiconductor devices are made, such as silicon and silicon oxide, we can impart properties not present in the original materials. However, this process requires an extremely large volume of ions, and conventional machines have been unable to satisfy the productivity and cost requirements, which has been a major obstacle to practical applications of this process.

Development on the new KYOKA began in 2017 and was prompted by feedback from customers who wanted a machine capable of material modification for mass production. Through simulation-based analysis of ion beam trajectories and a series of mechanical, electrical, and software design improvements, we succeeded at developing a machine with mass production performance that could satisfy the market's needs. In addition to improving the functionality of the material itself, this machine also modifies the properties of the material in order to facilitate the subsequent semiconductor fabrication process, contributing both to improved device performance and to the advancement of manufacturing technology.

This article is based on results obtained from a project (JPNP 21009) commissioned by the New Energy and Industrial Technology Development Organization (NEDO). At Nissin Ion Equipment, we will continue to contribute to our customers' development and the achievement of a sustainable society as the first company to deliver innovative manufacturing equipment that the world needs.

[Features of KYOKA]

1. High processing performance

KYOKA is capable of high-throughput material modification processing at a rate of 25 wafers or more per hour.

2. A wide range of processing regions

KYOKA can also be used for material modification processes that require low-energy regions under 1 keV through the use of ultra-high-current ion beams. This expands the range of material modifications that KYOKA can be applied to.

3. Compatibility with diverse material modification processes

A variety of ion species can be generated to achieve optimal modification in accordance with the target material.

4. Compatibility with cutting-edge semiconductor manufacturing lines

KYOKA can handle 300-mm wafers and is suitable for use on cutting-edge semiconductor manufacturing lines.



The Newly Developed KYOKA

KYOKA will be exhibited through display panels and videos at SEMICON Japan 2023, an international trade show for semiconductor manufacturing equipment and materials (organized by Semiconductor Equipment and Materials International [SEMI]), which will be held at the Tokyo Big Sight from Wednesday, December 13 to Friday, December 15.

The Nissin Electric Group has been stepping up its efforts to promote the SDGs through its business operations. This accomplishment is related to the following goals among the 17 SDGs.

7. Affordable and Clean Energy

9. Industry, Innovation and Infrastructure