

Miniaturization Has Created a Contamination Problem for Chipmakers—AICELLO's Mission Is to Overcome It

As semiconductors shrink in size, microscopic factors are beginning to impact quality in ways previously unimagined. In this environment, the transportation of chemicals used in chip production has become a critical factor, and AICELLO is uniquely equipped to meet this challenge. *By Antoine Azoulay*

Since the invention of the first silicon transistor in 1947, semiconductor technology has progressed at a pace few could have imagined. What began with circuits measured in millimeters has now reached the realm of nanometers—millionths of a millimeter. To put that in perspective, today's semiconductor nodes are tens of thousands of times thinner than a human hair, smaller than most viruses, and far beyond the perception of the naked eye. This astonishing miniaturization allows billions of transistors to fit onto a single microchip, fueling the rapid performance advancements behind the smartphones, computers and medical devices we rely on every day.

Yet, as components shrink, maintaining purity at an atomic level throughout the production process has become one of the most formidable challenges in the semiconductor industry. At nanometer scales, even a micrometer impurity—a particle about one-thousandth of a millimeter in size—becomes a gigantic problem, threatening to disrupt the delicate structures within a microchip. These impurities, which can be stray particles, trace metal ions or volatile vapors, can originate from almost anywhere in the manufacturing environment. With such fine tolerances, every step in production, from chemical storage to equipment packaging, must meet extreme purity standards to protect the reliability of the final product.

One of the few solutions to control impurities during the transportation of semiconductor chemicals is the CLEANBARRIER (CB) bottle by AICELLO, a Japanese manufacturer renowned for high-performance packaging solutions tailored to advanced industries. Designed specifically for the semiconductor sector, CB bottles hold several advantages over the traditional glass bottles utilized to store the ultra-pure chemicals needed in chip production.

As blow-molded, multi-layered containers, CB bottles weigh just one-fifth of their glass counterparts and are also shatter-resistant, preventing potential accidents and



"Through R&D we are continuously finding new ways to minimize contamination."

Satoshi Morita,
President & CEO,
AICELLO Corporation



AICELLO's bottles are used to transport ultra-pure materials during advanced semiconductor processes, including EUV lithography



HYPERCLEAN™ bags are used for semiconductor manufacturing equipment parts and HDD packaging. (Left: MB22; right: MA24)

enhancing environmental safety. Additionally, CB bottles have set strict standards in controlling particles and metal ions. Unlike glass bottles, which require extensive pre-treatment—including chemical and ultra-pure water washing, rinsing, drying and particle removal—CB bottles are made from high-purity resin free of additives, eliminating the need for additional preparation. AICELLO also guarantees the metal ion levels within each bottle, providing a streamlined process that allows customers to save both time and money.

As chip fabrication advances beyond the nanometer threshold, even humans are considered contamination factors. Furthermore, with the rise of the artificial intelligence era,

the days of polishing single-function chips are over. Today's technological innovation requires semiconductor foundries to integrate multiple types of chips, each performing specialized functions, such as memory storage, logic processing or communication, all in one compact module. To support these advancements, new chemicals, gases and photoresists that can support the production of ultra-fine semiconductors are continuously emerging, leading industry experts to argue that packaging technology is reaching its limits.

To keep pace with these innovations, AICELLO has made research and development a corporate priority and is continuously finding new ways to minimize contamination from factors like elution, particles

and metal ions. Furthermore, the company has gone beyond its role as a supplier. Today, AICELLO collaborates directly with semiconductor material and equipment manufacturers, offering customized solutions that optimize purity across every stage of semiconductor production. This approach has enabled AICELLO to develop clean bags, which are used to package and enclose precise parts of semiconductor production equipment.

The company's HYPERCLEAN MA24, for example, is the world's first packaging solution to control and manage outgassing—the release of potentially contaminating gases from materials, which can lead to equipment issues and defects in the final chip. This innovative bag, primarily used for packaging semiconductor manufacturing equipment parts and other sensitive devices, provides a purity level unmatched by conventional polyethylene alternatives. According to industry sources, the MA24 was quickly adopted by one of the world's largest semiconductor equipment makers and is currently becoming a de facto industry standard for the storage and transportation of critical components.

"Our clean packaging technology really is one of a kind," explains Satoshi Morita, president and CEO of AICELLO. "To achieve this level of sophistication, we have had to push the boundaries of our own products and production processes. For example, we were the first to start bottle production within a cleanroom, something no one had considered doing before we began work in this field," he adds.

In an industry where even particles smaller than a virus can cause major disruptions, rigorous purity control has become a prerequisite. As miniaturization continues to intensify contamination challenges, AICELLO remains committed to advancing solutions that help chip makers meet these exacting standards.