# Imaging the Future

*Television sets have shifted from cathode ray tubes to liquid crystal displays, and cameras have progressed from film to digital. Here* Japan Echo *introduces two companies that have developed technologies to keep pace with these changes and expanded the possibilities of imaging.*

## Kotobuki Industries

### World's First Nanodispersion Mill

Color filters determine the image quality of flat-screen LCD TVs. To achieve stunning graphics, the light transmission rate must be enhanced by applying organic pigments with very small particles on the color filter as thinly and evenly as possible. This was enabled by the technologies of Kotobuki Industries Co., based in the city of Kure, Hiroshima Prefecture. A team in the Chemical and Environmental Machinery Division led by chief engineer Mitsugi Inkyo has developed the world's first nanodispersion mill. Since around 2000, nanoparticle organic pigments have been used to manufacture vivid-color liquid crystal displays.

#### Starting from Nothing

Kotobuki Industries was known locally as a company that has been manufacturing casting and machine products for the shipbuilding and steel industries since prior to World War II. In 1971 the company resolved to apply the machine manufacturing skills that it had developed over the years to build chemical machines. Chemical machinery includes devices for filtration, centrifugal separators, and grinders that process raw materials by breaking them down into smaller pieces, separating the particles, and so forth.

After studying chemical engineering at Hiroshima University, Inkyo joined Kotobuki Industries in 1972. He has been developing chemical machinery ever since.

"The first thing I developed after joining the company was filtration machines, and we really had to take it from scratch. We began by importing technologies and improving on them. In 1983 we decided to bring in new grinding technology for producing fine particles from a Swiss company. During the three-week training that I underwent, I was impressed by how the company maintained the world's most sophisticated technologies and eyed the global market despite its small size. I came to feel that our company should also develop technologies that would win worldwide recognition, and we set out to develop a grinding mill of our own."

The basic idea of grinding mills is as follows: Tiny beads made of such materials as glass and ceramic are churned with the raw material to be ground, and collision with the beads reduces particle size through fracture or surface delamination. The particles are then separated from the beads by screening.

Chief Engineer Mitsugi Inkyo

In 1986 Inkyo and his colleagues completed the Apex Mill, a grinding mill that prevents clogging to enable stable operations by applying pressure and enlarging the holes in the screen. The new mill made it possible to produce particles of between 0.1 micron and 10 microns in diameter using 0.5-millimeter beads.

#### Focus of Global Attention

Sales of the Apex Mill were steady, but around 1990 Kotobuki Industries embarked on the develop-

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**Capital:** ¥48 million
**Employees:** 500
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ment of another grinding mill that would work with even smaller beads. At the time, 0.3 millimeter was believed to be the minimum feasible size of the beads, as reducing the mesh size of the screen to accommodate smaller beads would cause clogging. Likewise, the limit to the size of the resulting particles was thought to be 0.1 micron.

To overcome this limit, Kotobuki Industries came up with the idea of using the difference in the weight of the beads and particles to separate them by centrifugal force instead of screening. It immediately began conducting experiments and developed the Ultra Apex Mill in 1995. The mill was compatible with beads of just 0.1 millimeter, the world's smallest at the time. But even with beads of this size, the particles could not be ground any finer than 0.1 micron.

Just when it appeared as if all the work would go to waste, Inkyo relates, "We learned from one of our clients at the time that our machine was capable of dispersing submicron particles." Dispersion is a principle whereby aggregated particles are separated by giving them a small blast. The inherent properties of particles cannot be exploited without dispersing them, but nanoparticles—which are much smaller than submicron particles—were thought to be impossible to disperse, as the tendency to aggregate increases with decreasing particle size.

Ultra Apex Mill

"We tried putting aggregated nanoparticles through the Ultra Apex Mill and were able to confirm their dispersion." That was the moment when a machine created as a grinding mill became the world's first nanodispersion mill.

There had been no reported cases at academic conferences or anywhere else of the successful dispersion of nanoparticles at the time. "This was something unheard of even in laboratories, and people were surprised to hear that we were going straight to commercial production," says Inkyo.

Initially, the Ultra Apex Mill did not sell at all. "We only sold ten machines in the first three years," Inkyo wryly recalls. "A lot of people had no idea what *nano* meant, and our first step was to patiently go about explaining to our clients what nanoparticles were."

Things turned around in 2000, when the US government announced the National Nanotechnology Initiative, piquing international interest in nanotechnology.

"As we had already accumulated the needed technology, we virtually dominated the market. Since then, we've worked on improving the mill's performance by making it compatible with smaller beads. It can now run on beads with a diameter of 0.008 millimeter, and domestic and international sales together have reached about 400 units."

In addition to LCDs, the nanoparticles produced with the Ultra Apex Mill are put to a variety of uses, including inkjet printers, drugs, cosmetics, electronic components, and photocatalytic products. The mill attracts plenty of attention at nanotechnology exhibits overseas, and the company has received orders from South Korea, Taiwan, and other Asian countries, as well as from the United States.

## Competing in the World Arena

"We engineers spend each day striving to do what nobody else has done and to make better products than those of other companies," comments Inkyo on why Kotobuki Industries succeeded in becoming the first to develop a nanodispersion mill. "I think that persistence is what leads us to develop new technologies. What's important is to take on new challenges with the awareness that we're competing in the global arena."

Another point that Inkyo considers key when eyeing the global market is ease of use. "We can't provide frequent maintenance to overseas clients after delivering our products, so it's important that they be easy to use and trouble-free. And to make such products, we always make an effort to think simply when developing them and to create machines with simple structures."

# Newly Corporation

## Technology for Scanning 3D Objects

Based in the ancient capital of Kyoto, Newly Corporation has pulled off what had been considered very difficult—scanning three-dimensional objects—by refining its charge-coupled device and image analysis technologies. Newly's Scamera line of scanners have been acclaimed for their groundbreaking ability to scan three-dimensional objects and generate high-definition reproductions.

### The Shift to Digital

Newly Corporation was founded in 1979 by 12 engineers in image-processing technology. In its early years, it primarily repaired prepress scanners. Prepress scanners are input devices that capture photographic images by running optical beams over them and transferring the data to a computer. A photoengraving scanner it developed in 1984 won kudos from the printing industry for its vivid colors, and one printing factory after another replaced its old equipment with Newly scanners. Newly went on to develop scanners for use in other businesses, such as construction, and quickly expanded to more than 100 employees.

Around 2001 dark clouds began to loom over Newly, as the collapse of the IT bubble dampened economic growth. The trend in plate making was shifting from film-based to electronic systems, moreover, which relied on electronic data from digital cameras. Leading overseas manufacturers pulled out of the scanner market, and many said that scanners were destined to oblivion.

It was in this midst that Atsuo Ida, one of the founders, took over as company president. "Should we explore new possibilities for scanners or shift to new fields? Should we close shop? In the end, after pondering all the choices, we decided to stick to scanners. We were determined to come up with scanner technologies that had been unthinkable until then and generate new needs in the market," Ida recalls.

### Responding to Client Demands

Around this time, Newly received a request to make a special large-size scanner for printing auction catalogs. The client had been using a small machine to scan large paintings, which it did by capturing one section at a time and then merging the parts into a whole. This was highly troublesome, and the resulting images were not very impressive either.

To meet this request, Newly developed a machine capable of scanning large paintings in one go. Happy with this scanner, the client then asked for another that could scan paintings without the need for contact with its glass plate—to prevent damaging their surface. In ordinary scanners the scanning unit, being bulky, is installed under the glass. But by downsizing the scanning unit, Newly's development team made it possible to scan objects from above.

The client came back with an even tougher demand. This time it wanted a scanner for three-dimensional objects. "We hit on the idea of developing a totally new scanner that combined the advantages of both a scanner and a camera: the two-dimensional resolution [high-density pixels] of a scanner and three-dimensional expression of a camera," explains Ida. "And from there, we figured we could take it a step further and make a scanner that reproduces the appearance of objects exactly as people see them. With that scanner, lasting digital data could be created for all sorts of three-dimensional subjects, reproduced as two-dimensional images that appear three-dimensional due to an optical illusion. Everyone at Newly worked together toward the goal of developing these image processing technologies into our core technologies, and in 2003 we came out with the Scamera, a multiangle scanner."

President Atsuo Ida

### Reproducing Surface Asperity

The Scamera scanners are unique

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**Employees:** 143
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in their ability to scan objects from various angles. When viewing an object, people tilt it and move it around to observe its surface features. By freely moving the scanning unit—equivalent to the human eye—Scamera can more faithfully reproduce what the human eye sees.

Conventional scanners scan paper documents using a CCD scan head from below. While these scanners can accurately reproduce textual information, they are not adept at capturing subtle surface irregularities and shades. With oil paintings, for instance, the resulting images are flat and featureless, the asperities of the original having been lost.

By contrast, the Scamera uses a multiangle CCD scan head. The unit can be tilted to the optimal angles for scanning the subject's surface, allowing it to capture the slightest nuances. This innovation has made it possible to realistically reproduce surface textures like never before.

"Even the most amazing technologies won't do much good for a company unless it carves out new markets by presenting consumers with the things that can be done with them," says Ida. "With SMEs, in particular, there's no time to waste. I know of many companies that went bankrupt despite having superb technologies. So at Newly, we came up with a number of scenarios of what you can do with the Scamera and used them to aggressively market it to clients.

"Digital archiving was one of those ideas. We promoted the use of our scanners in academic settings, as a tool for restoring valuable works of art and craft, and we've delivered our products to temples in Kyoto and national museums, among other places.

"The Scamera can also be applied to interior design; we're doing well with our deceptively real bamboo replicas and tatami-pattern sheets. In addition to orders from food, textile, and other manufacturers, we're beginning to see more demand in new areas, such as film sets. Harnessing the ability of our products to reproduce textures, we hope to stimulate new demand in all sorts of areas."

At the International Luxury Travel Market held in 2007 in Cannes, France, the banquet venue featured a room replicating the temple Kodai-ji in Kyoto, and the guests all marveled at the reality of the bamboo, stone pavement, folding screen, tea room, and other features reproduced with the scanner. Ida hopes to create international demand for the Scamera in diverse domains, particularly as a tool for introducing Japanese culture overseas. HJ

**Scanned with Newly's Scamera, a plate of sushi looks real enough to make people reach out for a piece.**