SEMICON® West2014

Next-Generation Packaging Solutions

USHIO Exposure Business Unit Profile

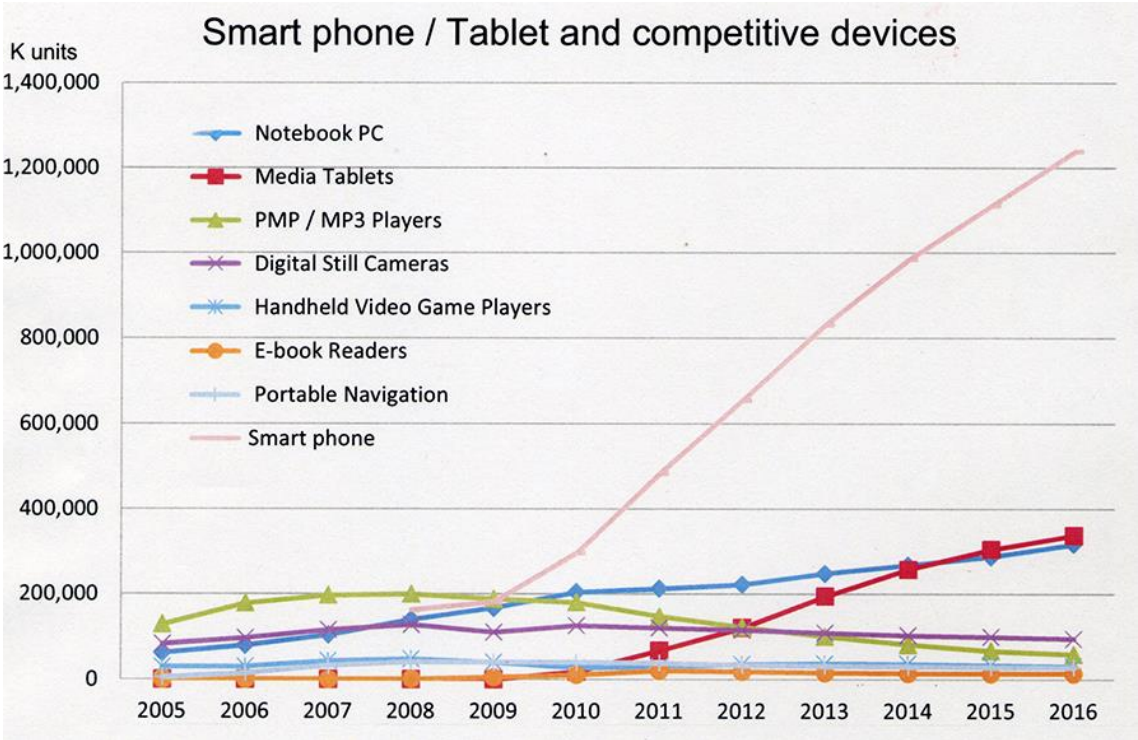
USHIO INC., celebrating its 50-year anniversary, has been serving the global semiconductor industry as a leading supplier of UV lamps for photolithography processes, VUV lamps for surface improvement, and halogen lamps for thermal processes.

From these light sources and their lamp housing units, we at USHIO have expanded our proprietary application technologies based on the development of new light sources and lighting-edge technologies. We began to develop, manufacture, and market UV hardening systems and peripheral exposure systems that harden photoresist and remove photoresist from the wafer periphery based on our UV light sources back in the mid-1980s. This was the start of our equipment business for semiconductor fabrication processes.

Since then, we at the USHIO Exposure Business Unit have developed, manufactured, and marketed a wide range of lithography tools for advanced packaging (fine-printed circuit boards), wafer-level packaging (WLP), MEMS, LEDs, and power devices — all of which are the focus of attention in the semiconductor fabrication arena. Today, more than 1,300 units of USHIO lithography tools are operating worldwide.

2014 Trend in Semiconductor Industry - Where We Are

Smartphones, tablet PCs, automobiles, industrial machinery, and the Internet of Things are major drivers to increase the demand of both low-end and high-end semiconductor devices. In particular, smartphones have been and will be the biggest contributor to the semiconductor industry.



Smartphones/Tablets and Competitive Devices

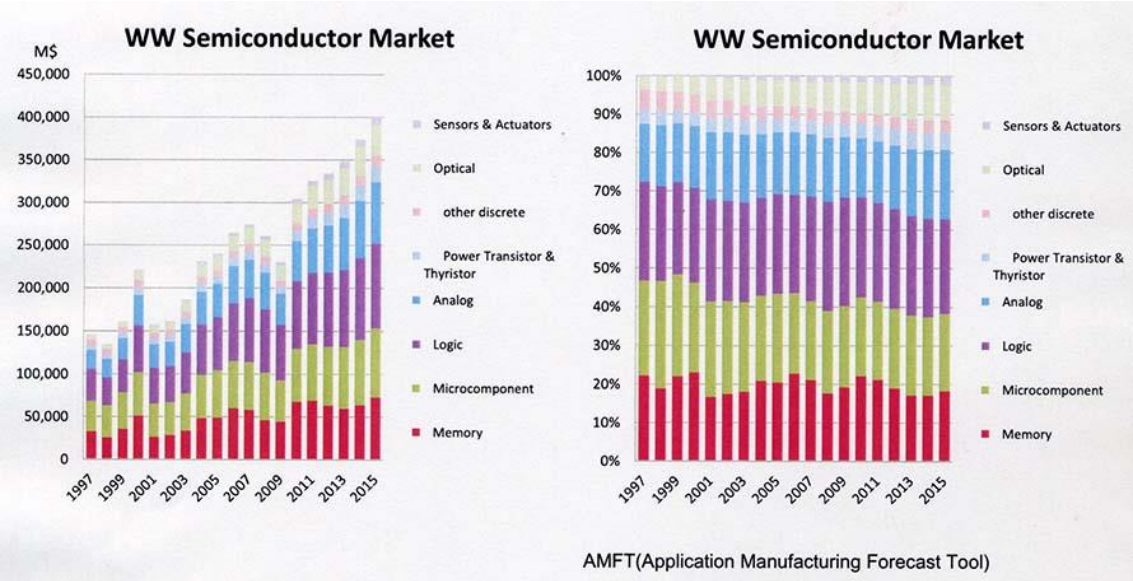
(Source: iHS)

Volume production of 2.5D/2.1D devices and next-generation DRAMs using 3D structures has become reality, while the markets for MEMS and power devices and LEDs will continue to grow. The semiconductor businesses are now relying on not only high-end devices but also More-Than-Moore devices.

USHIO is well positioned in this market trend and is able to provide a series of lithography tools that covers 3D/2.5D/2.1D packaging applications that are essential to manufacturing of high-density semiconductor devices and require high productivity as well as further reduction of production cost.

More Than Moore Devices Are Expanding

The following graphic makes it apparent that more-than-Moore devices — including power devices, sensors, and LEDs — will expand in the next decade as green technology and Internet-of-Things products become more and more important.



Source: iHS

USHIO's Lithography Tools — Providing Next-Generation Packaging Solutions

Among such packaging applications as previously mentioned, 3D packaging applications using through-silicon via (TSV) will become the mainstream for high-end memory devices within five years or so. On the other hand, 2.5D/2.1D packaging has become the fastest growing segment rather than merely a transition to 3D packaging, because of its performance and economic advantages; interposer substrates, in particular, are one of the most critical components to increase the applications of 2.5D/2.1D packaging. While the main material of the interposer today is silicon, both glass and organic substrates have been increasingly considered as promising alternatives.

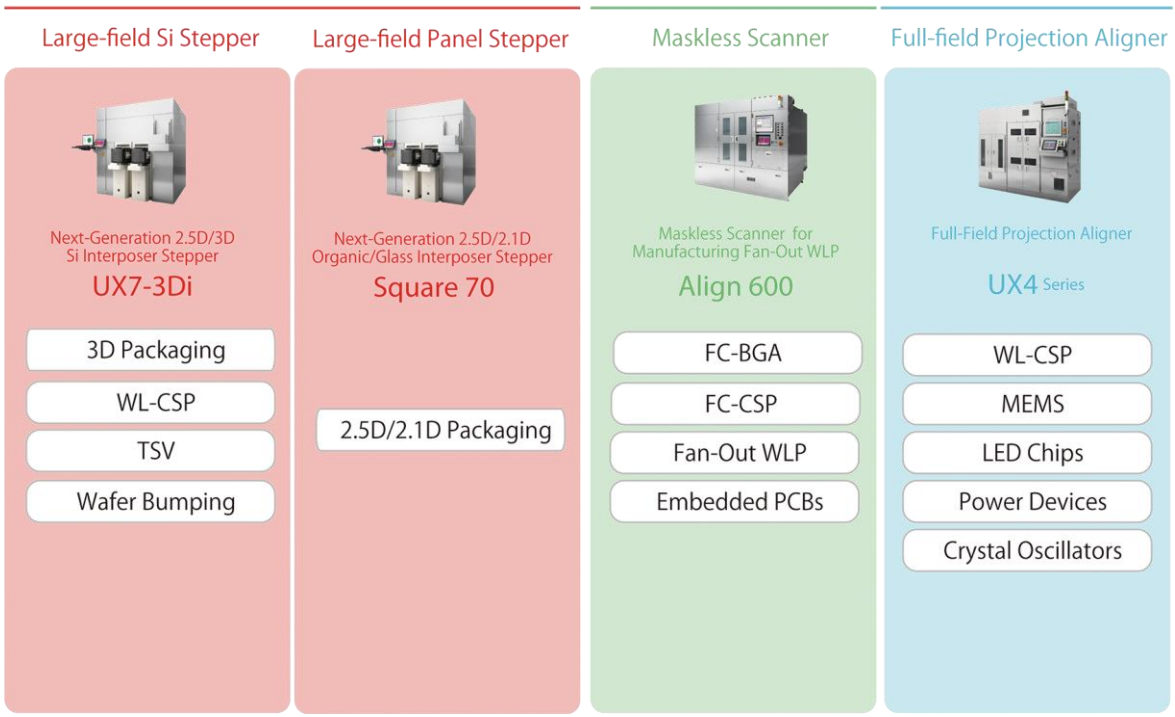
Today, 3D packaging applications that use TSV and 2.5D/2.1D packaging applications have been spotlighted as emerging technologies for higher integration of semiconductor devices.

At SEMICON West 2014, we are introducing the UX7-3Di LIS 350 stepper for 3D/2.5D silicon interposers. This unit achieves significant cost reduction with its unparalleled performance, including single-shot exposure of large substrate areas, high throughput, and high resolution of 2 µm L/S (Line and Space). We also are introducing Square 70, a large panel stepper dedicated to the manufacture of 2.5D/2.1D interposers that allows processing of glass and organic substrates.

In addition, we are introducing the Align 600 maskless scanner for fan-out WLP, which enables alignment at 600 points to achieve high yield, and the UX4 series of full-field projection aligners for LED, MEMS device, and power device applications.

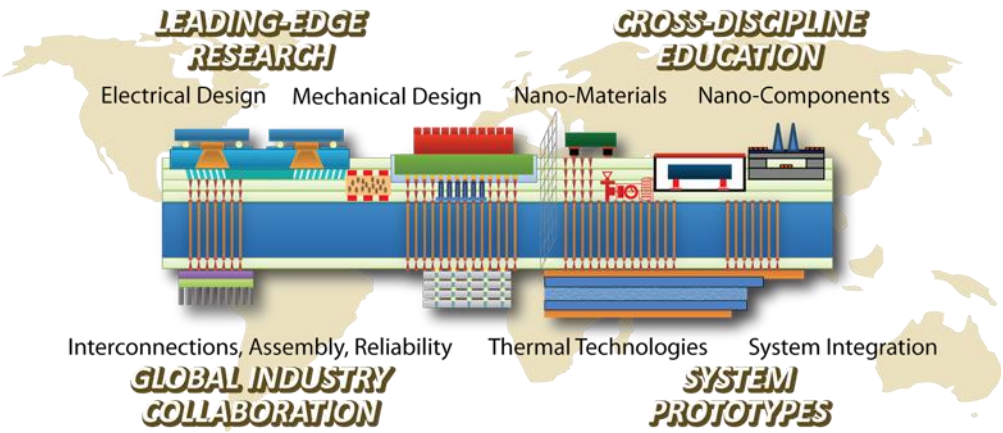
As a provider of reliable and high-performance lithography tools, USHIO has made a great contribution to the high-volume production of advanced packages such as those described above, and achieved significant cost reduction in the manufacturing of high-end digital products such as smartphones, tablet PCs, and other mobile devices.

USHIO's Major Lithography Tools and Packaging Applications



USHIO Participating in 2.5D Interposer Consortium Sponsored by Georgia Tech 3D Systems Packaging Research Center (GT-PRC)

Based on a partnership agreement with the Georgia Tech 3D Systems Packaging Research Center (GT-PRC) (GT-PRC) in June 2013, USHIO has leased and installed a projection aligner dedicated to developing 2.5D glass substrate interposers at GT-PRC.



(Source: GT-PRC)

GT-PRC has formed a global industry consortium of end users and supply chain manufacturers to further promote the development of both 2.5D/2.1D super-thin glass and organic interposers.

As a participant in this consortium, USHIO has installed at GT-PRC a leased projection aligner mounted with the same projection lens as its latest panel interposer stepper, the Square 70, to provide the needed lithography technology for emerging glass and organic interposers. USHIO is now aggressively developing the lithography technology dedicated to 2.5D/2.1D glass and organic interposers, including testing of exposure on large and thin glass substrate as well as achievement of the target resolution (L/S) of 1 to 5 µm required to achieve these finer patterns. USHIO also has dispatched an engineer to support reduction of the cost required for developing the glass interposers and packages.

We at USHIO believe that our participation in this program will build momentum to provide our leading-edge lithography technology for the advanced packaging industry. We also expect that it will help to increase the market share of USHIO's lithography systems, which have a competitive edge particularly for panel substrates, as well as accelerate the development of peripheral technologies for lithography.

Large-Size Si Interposer Stepper “UX7-3Di LIS 350” for 300-mm Wafers

Allowing Significant Reduction of Cost for Manufacturing Large-Size Interposers for 3D/2.5D Packaging

Today, 3D packaging applications that use through-silicon via (TSV) and 2.5D packaging applications have been spotlighted as the emerging technologies for higher integration of semiconductor devices. Maintaining an optimum balance between technologies and cost for volume production has become one of major challenges for these next-generation packaging applications. In order to provide the best solution for this challenge, USHIO’s UX7-3Di LIS 350 stepper for 3D/2.5D silicon interposers achieves significant cost reduction with its unparalleled performance including single-shot exposure of large substrate areas, high throughput, and high resolution of 2 µm L/S (Line and Space). As a world-premiere photolithography tool provider for 3D and 2.5D packaging solutions, USHIO leverages the industry’s most advanced development capabilities to meet the increasingly sophisticated and divergent product requirements of the global semiconductor industry.

UX7-3Di LIS 350: 3D /2.5D Si Interposer Stepper

UX7-3Di LIS 350 Features

- Large field size: 78 x 66 mm
- Can process silicon wafers of up to 300 mm in diameter
- High overlay accuracy of 500 nm or less
- Innovative alignment with IR that transmits Si to allow the bottom alignment required for TSV (Through-Silicon-Via) applications indispensable to Si interposers
- High throughput of 120 wafers per hour for 300-mm wafers

UX7-3Di LIS 350 Specifications

Resolution:	Up to 2.0µm L/S
Wavelength:	365 nm
Overlay Accuracy:	Front <500 nm, Back <500 nm
Throughput:	300-mm wafers: 120 wph
Lens Field Size:	78 x 66 mm
Substrate Size:	Wafers of up to 300 mm in diameter
Substrate Transfer Method:	Wafers: Automated transfer

2.5D/2.1D Large Panel Interposer Stepper “Square 70”

Allowing the Manufacture of Glass and Organic Interposers for 2.5D/2.1D Packaging

The Square 70 stepper system for large panel interposers allows manufacturing of organic and glass interposers for 2.5D/2.1D packaging that have recently become popular, as well as Si wafers.

It has the capability to process larger-size interposers without any stitch with a lens field size of up to 70 mm x 70 mm at a high throughput; the use of square substrate materials allows manufacturing of higher-density and lower-cost interposers.

Square 70: 2.5D/2.1D Large Panel Interposer Stepper

Square 70 Features

- Large field size: 70 x 70 mm
- Can process interposer substrates made of a variety of materials other than Si, including glass and organic materials
- Can process large substrates of up to 405 x 350 mm
- Has high overlay accuracy of 500 nm or less
- Optical and transfer systems are optimized for addressing a warp or expansion/contraction of an panel substrate

Square 70 Specifications

Resolution:	Up to 2.0 µm L/S
Wavelength:	365 nm
Overlay Accuracy:	Front <500 nm, Back <500 nm
Lens Field Size:	70 x 70 mm
Substrate Size:	Glass and organic substrates of up to 405 x 350 mm

Maskless Scanner “Align 600” for Manufacturing Fan-Out WLP

600 Alignment Points, High Resolution of 5 µm L/S and High Throughput of 40 Sec/Panel.

For Fan-Out WLP — a new packaging technology for multi-chip modules — USHIO has succeeded in developing the ultra-fine, high-speed maskless scanner “Align 600” with 600 alignment points, a resolution of 5 µm L/S and throughput of 40 seconds/panel.

The Align 600 maskless scanner allows 600 alignment points to be marked for alignment. It enables alignment and exposure of individual ultra-compact chips arranged in positions that vary when mounted on a wafer, thus making a great contribution to complete finer interconnection patterns.

Align 600: Maskless Scanner for Manufacturing Fan-Out WLP

Align 600 Features

- Ultra-high precision alignment with 600 alignment points
- Maskless
- High resolution of 5 µm L/S
- High overlay accuracy of ±5 µm
- High throughput of 40 seconds/panel

Align 600 Specifications

Number of Alignment Points:	600
Resolution:	5µm L/S
Overlay Accuracy:	±5 µm
Throughput:	40 seconds/panel

“UX4 Series” Large-Area, Full-Field Projection Lithography Systems

Optimum for Various Advanced Applications, including MEMS Devices, High-Brightness LEDs and Power Devices.

USHIO provides the “UX4 Series” of full-field projection exposure lithography tools for wafers of up to 300 mm in diameter to manufacture MEMS devices, high-brightness LEDs and power devices. Use of the mask-damage-free projection exposure method as well as the capability of full-field exposure of a wafer of up to 300 mm in diameter allows great enhancement of the productivity of and significant reduction for manufacturing the above products.

“UX4 Series” Large-Area Full-Field Projection Lithography Systems		
Model	Application	Wafer Size
UX4-MEMS FFPL 300	MEMS devices	Max. 300 mm
UX4-LEDs FFPL 200	High-brightness LEDs	Max. 200 mm
UX4-ECO FFPL 200	Power devices	Max. 200 mm

UX4 Series Common Platform: Large-Area, Full-Field Projection Lithography Systems

UX-4 Series Features

- Automated transfer of wafers up to 300 mm in diameter
- Completely non-contact so as to cause no mask damage; thus, no mask cleaning, inspection, or replacement is required
- Proprietary alignment technology that enables easy detection of low-visibility alignment marks
- Large depth of focus of 500 µm or less and special wafer chucking method allows high-precision exposure of warped or stepped substrates or thick photoresist
- Allows simultaneous projection of both sides of a wafer to enhance productivity
- Modular design of each function on a common platform allows easy future upgrades

UX-4 Series Specifications by Models

Model	UX4-MEMS FFPL 300	UX4-LEDs FFPL 200	UX4-ECO FFPL 200
Resolution:	2 µm L/S~		
Wavelength:	365 nm		
Overlay Accuracy:	±1µm (Top Side) ±1.5µm(Back Side)		
Throughput:	120 wph		
Wafer Size:	ϕ300 mm	ϕ100 mm/150 mm/200 mm	
Substrates:	Si, Sapphire, GaN, GaAs, SiC, and glass wafers		
Substrate Transfer Method	Automated wafer transfer on the UX4 Series platform		

Note: The specifications may slightly vary according to its application, such as for MEMS devices and high-brightness LEDs.

USHIO's High-Precision Projection Lens — Enabling Next-Generation Advanced Packaging Applications

USHIO is currently developing a large-field precision projection lens that can produce a super-high resolution of 1 µm L/S. Completion of this lens allows projection exposure of ultra-fine patterns of 1 µm L/S to meet the further requirement of finer patterns for advanced packaging.

USHIO Welcomes Demonstration Requests and Inquiries about Its UX Series Products

We at USHIO line up lithography systems using three exposure methods — step-and-repeat, maskless scanner, and full-field projection Aligner— to meet your application needs. To inquire about a demonstration or to request detailed information on these UX Series products, please contact:

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