Electronics Processing

The desire to know is natural to good men.

—Leonardo da Vinci

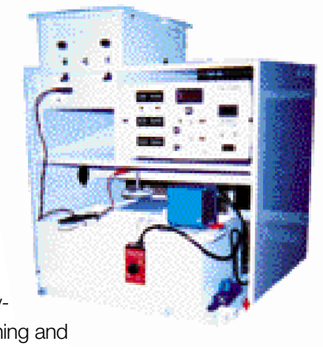
In electroplating, process control is crucial—particularly when electrodepositing small electronic and microelectromechanical devices. Process control is difficult to maintain when the feature size of these devices shrinks below the thickness of the static boundary layer that envelops the substrate being plated. Variations in bulk chemistry and fluid flow are ineffective. Here is a product that allows electroplaters to regain process control.

FIBRoplate™ IKo™

How It Helps: The FIBRoplate IKo electroplating system allows electroplaters to manage the boundary layer thickness. By agitating the electrolyte solution around the features, the boundary layer can be reduced by up to 90 percent, which allows greater process control. Compared to its nearest competitor, the system is 25 percent smaller—it is the smallest electroplater footprint on the market—and consumes 75 percent less electroplating solution.

How It Works: FIBRoplate IKo uses unique fibrillic applicators, or brushes, to agitate the electrolyte solution around the features without damaging them. These soft applicators are positioned 5 to 10 microns from the surface. When in motion, they cause circulation of the electrolytic solution near the substrate. This effectively reduces the boundary layer thickness and enables process control. Bulk chemistry and fluid flow can still be used to affect the plating results; however, a new level of process control can be achieved by varying the motion of the applicators.

How Much It Will Cost: The base price for the FIBRoplate IKo is $30,000. This cost is about half that of its nearest competitor.

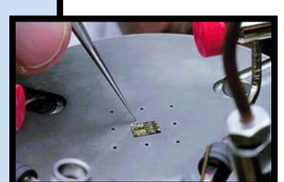


When It Will Be Ready: The electroplating system is available now. Bench-top electroplaters for microelectromechanical and nanoelectromechanical applications have been sold to universities and research institutions.

Who Is Working On It: The innovator is ElectroChemical Systems, Inc. (ECSI). ECSI was founded in 1989 by Dr. Igor Kadija. The company focuses on designing, building, and supplying practical, precise wet-processing equipment for micromachining and microelectronics R&D and manufacturing. It retains three subcontractors with expertise in machining, plastics, and electronics design. It occupies a 1,000-square-foot facility in Denville, New Jersey with quality control, wet processing, and bench-top testing capabilities. For more information, contact Igor Kadija of ECSI at (201) 670-8397 or ikadija@fibrotools.com. The company Web site is www.fibrotools.com.

MDA Origins

ECSI was awarded two BMDO SBIR contracts. In 1992 under a Phase I contract, the company demonstrated the electroplating applications of this technology by making copper interconnects on silicon. In 1993, under a Phase II contract, it started building an etching system based on the technology. However, because the cost of developing the etcher proved too high, ECSI returned to the plating application and completed a prototype. Ideally, BMDO could use this technology to create reliable, high-density interconnects for space weapons.



IonCell™

A company wants to supply coated glass to flat-panel display manufacturers. The glass must be coated with a very thin, uniform layer of indium tin oxide (ITO). With conventional sputtering processes, controlling the material deposition on the glass is difficult, and a too-thick, nonuniform layer of ITO could compromise the performance of the display. Here is a product that could enable more process control in these sputtering systems.

How It Helps: IonCell cesium cartridges allow better control over the thin film deposition process, resulting in higher quality thin films. These cartridges can be implemented as a modification to existing proprietary sputtering systems, eliminating the need to purchase new equipment because the modified $1 million unit can perform like a $10 million unit. The cartridges are easy to install, similar to an ink cartridge for a printer, and last approximately 200 hours of sputtering time. No special handling or hardware is required.

How It Works: IonCell cesium cartridges supercharge vacuum deposition processes, allowing manufacturers to generate ITO coatings with enhanced and controlled properties. The cartridges are designed to be inserted into an injector assembly, which can be attached to any proprietary sputtering system. This injector transforms a conventional sputtering system into an ionized physical vapor deposition source. In the assembly, a heater heats the cesium cartridge, causing it to expel neutral cesium particles. The introduction of cesium into the process causes ionization of the sputtered material. The negative ions produced by the bombardment of the target are repelled by the target material and are directed toward a substrate. The substrate can be grounded or can be positively biased to attract the sputtered ions, providing a higher level of control over the formation of a very thin, smooth, and uniform layer of material.

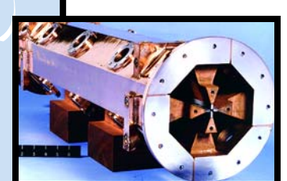
How Much It Will Cost: The purchase price of the IonCell cesium cartridges is about $200 each.

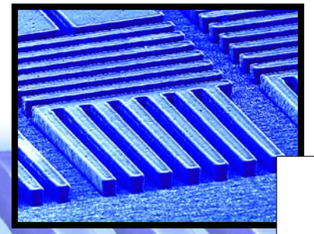
When It Will Be Ready: The cesium cartridges are available now. Hanwha L&C Corporation, a South Korean company involved in plastics, chemicals, automotive parts, and other materials, recently purchased a proprietary sputtering system that incorporates an IonCell cesium-based injector subsystem. The company will use this technology to produce thin-film ITO coatings on glass for organic light-emitting displays.

Who Is Working On It: The original developer of the cesium technology was SKION Corporation, which merged with Plasmion Corporation in 2001. Plasmion develops leading-edge thin-film application technology for the display, semiconductor, storage disc, and optical communications industries. The company employs 20 people (9 with doctoral degrees) and occupies a 20,000-square-foot facility that includes state-of-the-art vacuum coating and testing systems and analytical instruments. Additional funding has been provided by The Egg Factory, LLC, a venture capital group. For more information, contact Steven Kim of Plasmion at (201) 963-5450 or skim@plasmion.com. The company Web site is www.plasmion.com.

MDA Origins

Dr. Steven Kim, founder of SKION and Plasmion, developed the fundamental principles of this technology for use in a neutral particle beam weapon with the support of SDIO and BMDO in the late 1980s and early 1990s. In 1996 and 1997 under BMDO SBIR Phase I and II contracts, SKION investigated the use of super-high brightness electron-emission film for field emission displays in ballistic missile defense systems.



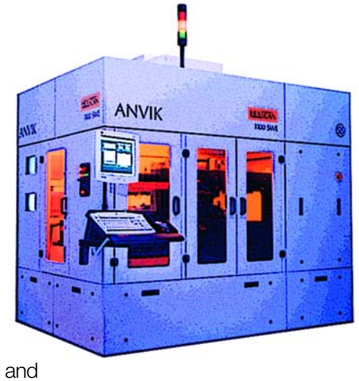


Electronics manufacturers have been frustrated by the limitations of today's lithography and patterning equipment. Standard projection lithography and printing systems can produce small features but have limitations when it comes to large-area substrates. Stepping systems can accommodate larger substrates but have restricted throughput and lower yield. Here is a product that ends the frustrations of electronics manufacturers.

Hex-Scan™

How It Helps: Hex-Scan lithography systems combine large-area imaging capability with high resolution and high throughput to enable high-volume, cost-effective production of a wide range of microelectronic and optoelectronic products. This combination eliminates the limitations of other lithography tools, including contact and proximity tools, conventional projection systems, steppers and scanners, and direct-write machines. Further, these systems are highly modular, allowing for equipment upgrades and user-specified configurations.

How It Works: Hex-Scan lithography systems use patented hexagonal seamless scanning technology to enable operators to deliver the desired resolution over very large substrate areas. The substrate and mask are mounted on a single planar stage that scans in two directions. An excimer laser illuminates the mask from below in a hexagon-shaped region, which is imaged onto the substrate by an all-refractive projection lens. A reversing unit ensures that the image has the same orientation as the object. The single planar stage causes the mask and substrate to move together in a scan-and-repeat serpentine fashion until the entire substrate is exposed. The complementary overlap between adjacent scanning areas produces seamless exposure.



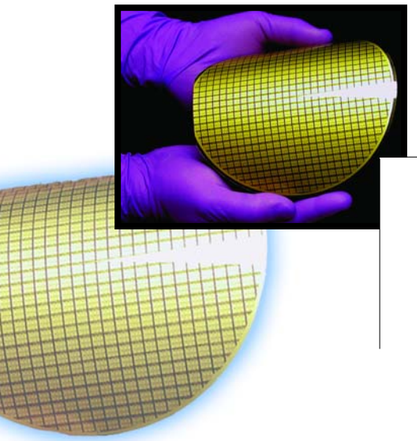
How Much It Will Cost: These systems range from $600,000 to $1.5 million depending on the model and its levels of customization and automation. This cost is far less than the $5 to $7 million for traditional stepper machines.

When It Will Be Ready: Lithography systems are now available for printed circuit boards, high-density interconnects, optoelectronics, microelectromechanical systems, and displays (both rigid and flexible). Swedish companies Sheldahl and Acreo AB, as well as a Fortune 100 company in the United States, have purchased these lithography systems for volume manufacturing of microelectronic products.

Who Is Working On It: Anvik Corporation developed this product. The company designs, develops, and manufactures advanced optical systems and equipment for microelectronics, optoelectronics, microsystems, and biotechnology applications. It occupies a 12,000-square-foot manufacturing and technical facility, with well-equipped laboratories for optics, electronics, and microelectronic processing, and has powerful software design tools for optical engineering. Founded in 1995, Anvik currently employs 10 people. For more information, contact Marc Zemel of Anvik Corporation at (914) 345-2442 or mzemel@anvik.com. The company Web site is www.anvik.com.

MDA Origins

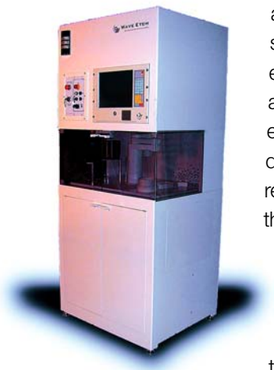
Anvik's lithography system could help shrink the size and improve the performance of electronic circuitry used in missile defense systems. For this reason, BMDO funded the company's SBIR Phase I and II research, which ultimately resulted in a submicron-resolution, large-area, high-throughput lithography system. Additional research funding was obtained from DARPA, the U.S. Army, the U.S. Air Force, and the National Science Foundation.



A start-up firm develops a better optoelectronic wafer and wants to process the backside without disturbing the frontside. But the devices on the backside are too sensitive to undergo the thinning processes that immerse the entire wafer in etching fluid. Here is a product that allows single-side processing with high yield and at low cost.

WaveEtch™

How It Helps: WaveEtch™ single-sided wet processing system safely thins wafers and shaves production costs. One advantage of WaveEtch's single-sided processing of microelectromechanical and optoelectronic devices is that it does not affect the side of the wafer with structures or devices already on it. A second advantage is that WaveEtch does not create subsurface damage, thereby protecting applications that are repeatedly heated and cooled or subject to mechanical stress. A third advantage is high yield. Other processes that can thin wafers to equivalent levels involve a two-step process—mechanically grinding down the wafer to a certain level, and then chemically thinning the remainder. Such grinding techniques produce low yields and drive up the costs of chip production. A fourth advantage is the system's low capital cost and cost of ownership, which can be a fraction of comparable tools.



How It Works: The WaveEtch single-sided wet processing system uses a patented process, called dynamic confinement technology (DCT), to thin semiconductor wafers. DCT uses fluid dynamics to confine solutions that "eat away" or etch a wafer surface. This process has been qualified for wafers from 625 microns to 50 microns thick, and can work with virtually all semiconductor materials. It is a cost-effective, high-yield approach to reducing large-area, high-quality substrates with no front-side damage. Only the side being thinned is touched by the solution.

How Much It Will Cost: Depending on options and the number of processing stations, prices range from $400,000 to $1.7 million. These prices are one-third to one-tenth that of other thinning processes.

When It Will Be Ready: The system is available now. With more industries moving towards single-sided wafer processing, WaveEtch makes the perfect platform to tap this upcoming and fast-growing market. In fact, some of the world's top 50 wireless, optoelectronic, and high-frequency communication device manufacturers are now using WaveEtch technology to create charge-coupled devices, focal plane arrays, optical nanostructures, and other optical and optoelectronics components.

Who Is Working On It: The innovator is Materials and Technologies Corporation (Matech), incorporated in 1992. The company intends to be an industry leader in developing single-sided wafer processing systems. It employs 10 people and occupies 5,000 square feet of office and manufacturing space in Poughkeepsie, New York. For more information, contact Dr. Ricardo I. Fuentes of Matech at (845) 463-2799 or fuentes@matech.com. The company Web site is www.matech.com.

MDA Origins

BMDO funded the development of Matech's wafer-thinning process to produce wide bandgap silicon carbide (SiC) substrates for high-power, high-frequency radar applications. A thinning process that would strip away the sacrificial layers on SiC substrates was required, but not commercially available. In 1996, BMDO awarded an SBIR Phase I contract to Matech to show feasibility and demonstrate DCT to produce large-area SiC-on-insulator–compliant substrates for low-defect, lattice-matched, wide bandgap semiconductor growth. In 1997, BMDO awarded an SBIR Phase II contract to Matech to further develop the DCT process for direct commercialization.