SAMBA™ Technology Backgrounder

- Silicon MEMS Processes
- Silicon MEMS Printhead Technology
- SAMBA Technology, Printhead, and Printbar
- VersaDrop™ Variable Drop Technology

SAMBA Overview

SAMBA is an extensible "printhead on a chip" technology that is analogous to the evolution of the Integrated Circuit (IC) from a single chip with limited functionality to Large Scale Integration (LSI) incorporating thousands of integrated functions. This breakthrough in printhead design results in the potential of having the packing density and cost of Thermal Ink Jet (TIJ), coupled with the high throughput of Continuous Ink Jet (CIJ) yet providing the operational flexibility associated with Piezo Ink Jet (PIJ).

Developed jointly by FUJIFILM Dimatix and FUJIFILM Corporation, SAMBA™ drop-on-demand inkjet printheads utilize Dimatix' proprietary Silicon MicroElectroMechanicalSystems (Si-MEMS) fabrication methods combined with our powerful VersaDrop™ multi-pulsing jetting capability. Collectively, these technologies and other innovations enable printhead nozzles to be arranged in a matrix array with enhanced meniscus control and ink recirculation to provide unparalleled stability, uniformity, maintainability and scalability in a compact package.

Due to its scalable design, SAMBA enables individual printheads to be placed in close proximity to each other to form a single, tightly integrated printbar. These printbars can be varied in both length and resolution to accommodate industry standard press sizes serving diverse printing applications from multi-page signatures to wide format graphics printing. Multiple printbars can be configured in precisely aligned, adjacent clusters to enable high-speed single pass grayscale printing of multicolor inks. SAMBA's robust material set is tailored to accommodate a broad range of ink chemistries which enable both materials deposition and specialty printing applications in addition to conventional graphics printing.

SAMBA drop-on-demand inkjet printhead technology is a key enabler of the FUJIFILM JetPress 720.

Silicon MEMS Processes

As a leading developer and manufacturer of state-of-the-art piezoelectric printheads and related components, FUJIFILM Dimatix has played a critical role in making industrial piezoelectric inkjet technology the mainstay in digital wide format graphics, coding and marking, and addressing applications. Multiple generations of our drop-on-demand printheads are now in use in high performance non-impact imaging and precision deposition equipment throughout the world. Few of Dimatix' earlier advancements or those of others, match the impact of our proprietary Si-MEMS manufacturing processes on inkjet productivity, reliability, quality and efficiency for small drop, higher resolution, non-impact printing and deposition applications.

Unlike the manufacture of laminar inkjet printheads, SAMBA inkjet printheads used within the FUJIFILM JetPress 720 are fabricated on silicon wafers; in much the same way large scale integrated circuits such as computer chips are made.

MEMS describes a set of processes developed out of the integrated circuit industry used to "sculpt" and assemble IC-sized mechanical structures – micro machines – responsive to minute electrical currents in performing highly specialized tasks.

A preferred construction material for MEMS printheads is silicon for its superb resistance to mechanical abrasion, tolerance to high temperatures, and excellent robustness to chemical attack.

The FUJIFILM Dimatix Si-MEMS processes operate in sub-micron dimensions. The combination of silicon material with extremely small geometries allows our Si-MEMS processes to produce operationally robust, chemically resistant, highly reliable, and incredibly compact inkjet printheads.

Silicon MEMS Printhead Technology

In addition to providing excellent processes for rendering of thin and compliant membranes, an optimal jetting design needs to address two key structural objectives. First is removing the piezoelectric PZT crystal from the path of often-aggressive jetting fluids while overcoming the source of mechanical crosstalk inherent in shared wall designs. Second is building a jetting structure of a size suitable for high productivity print applications. While most MEMS devices measure on the order of 1mm in length, FUJIFILM Dimatix set out to build jetting structures in the 10s of mm in length, which requires substantially greater control over planar dimensions than what is typically achieved with standard MEMS.

Instead of placing the PZT crystal between the jet walls, the FUJIFILM Dimatix Si-MEMS technology incorporates the PZT crystal onto a thin barrier layer atop the ink channel to form the pumping chamber. In this way, the entire micro-array is fabricated as a single silicon monolithic structure. This results in a highly efficient high-resonant-frequency jet design with no contact between the jetted material and the PZT crystal.

By shaping the silicon nozzle, the Dimatix Si-MEMS technology tackled a major impediment to jetting accuracy and uniformity-- precise control of the nozzle's shape and absolute position on the silicon dies facilitating even higher drop placement accuracy over greater throw distances.

SAMBA Technology, Printhead and Printbar

SAMBA technology is a quantum leap forward that redefines how Piezo DOD inkjet technology can be designed, manufactured and applied. SAMBA marks the first comprehensive Piezo DOD inkjet platform that truly delivers on the promise of wide-width, high resolution, single pass, drop-on-demand inkjet printing without having to trade off quality, redundancy or print width, and achieves it in an elegant, compact form. As an extensible "printhead on a chip" technology, the introduction of SAMBA is not unlike the Integrated Circuit's (IC) evolution from a single chip with limited functionality into Large Scale Integration (LSI) incorporating thousands of integrated functions. This innovation in printhead design has exhibited the potential of having the packing density and cost of Thermal Ink Jet (TIJ), combined with the high throughput of Continuous Ink Jet (CIJ) while providing the operational flexibility associated with Piezo Ink Jet (PIJ).

Inside the printhead, the ink or fluid travels down one channel, through the filter, across and through the silicon die and then back up the outflow channel to allow continuous temperature and degassing control of the fluid. This flow continuously recirculates the ink or functional fluid providing fast start-up, high frequency jetting and non-stop operation.

SAMBA scalability enables many individual printheads to be aligned to form a single, tightly integrated printbar. Printbars can be varied in both length and resolution to accommodate industry standard press sizes serving diverse printing applications from multi-page signatures to wide format printing.

With SAMBA, high resolution, non-contact printing is achieved using a single, easy to align printbar. With currently available inkjet solutions, individual printheads must be arrayed and offset from one another to achieve a continuous, full page width print. Aligning these printheads to achieve a quality print is a painstaking, inaccurate and time consuming process. SAMBA unique nozzle geometry, layout and compact Si-MEMS structure allow printbars to be stacked in close proximity, with each printbar representing a different color ink or jetting fluid. These fluids can be ink or other jettable substances.

Native drop sizes ranging from 10 picoliter down to industry-leading 1 picoliter are made possible by FUJIFILM Dimatix' Si-MEMS fabrication methods, with even sub 1 picoliter feasible. The capability to scale the drop size combined with robust, chemically inert construction and ability to jet inks and other functional fluids accurately at full production speeds, makes SAMBA printheads, ideal for use with evolving materials deposition applications such as solar cell, flat panel display, and printed circuits manufacturing.

VersaDrop™ Grayscale at Production Speed

Precise control over nozzle shape and absolute drop position coupled with the high firing frequency, enables SAMBA to deliver high-accuracy, variable-drop jetting without affecting device throughput or productivity.

FUJIFILM Dimatix' patented VersaDrop technology takes full advantage of the inherent high frequency response of SAMBA to offer flexible and versatile printhead operation. VersaDrop jetting technology is the activation of the piezoelectric element with waveform pulses of varying amplitude to produce metered amounts of ink which are pumped into a single drop before the ligament detaches from the nozzle. This capability is used to form variable size drops with no compromise in jetting productivity.

In addition, the ability to precisely modulate the size and shape of individual ink drops, and accurately place them, gives VersaDrop jetting technology the ability to produce smooth tonal variations and extremely fine features. It also offers a more robust solution compared to other grayscale methods for modulating drop size by producing a single drop at high speed, rather than a burst of drops at significantly slower speeds.

Field-Proven

The same Si-MEMS manufacturing techniques used for SAMBA have been field-proven over the last several years in FUJIFILM Dimatix Materials Cartridges (DMC) used with the Dimatix Materials Printers DMP 2800 and DMP 3000. These products are employed routinely in many demanding materials deposition applications.

Applications run the gamut – from depositing picoliter-sized droplets of fluids such as liquid silver and organic fluids on surfaces including flexible substrates, flat panel and flexible displays and printable electronics, to bioscience and a wide variety of others – in addition to handling UV, aqueous, solvent-based and many other fluids jetted onto paper, vinyl and almost any other substrate imaginable.

About Fujifilm

FUJIFILM Dimatix, Inc., the world's leading supplier of drop-on-demand inkjet printheads for industrial applications, is driving a revolution in inkjet technology to support a new generation of products for printing, industrial product decoration and materials deposition. The company's innovative inkjet technology and world-class fabrication techniques enable OEMs, system integrators and manufacturers to build cutting-edge systems and manufacturing processes for high-performance, precision printing of traditional inks and deposition of functional fluids on all types of surfaces, including flexible substrates.

A wholly owned subsidiary of FUJIFILM Corporation, FUJIFILM Dimatix, Inc., is headquartered in Santa Clara, California and maintains U.S. product development and manufacturing operations in California and New Hampshire. The company sells and supports its products worldwide through offices in the United States, Europe, Japan, Korea, China, Taiwan and Singapore. For more information, visit www.dimatix.com.

FUJIFILM Holdings Corporation, Tokyo, Japan, brings continuous innovation and leading-edge products to a broad spectrum of industries, including electronic imaging, digital printing equipment, medical systems, life sciences, graphic arts, flat panel display materials, and office products, based on a vast portfolio of digital, optical, fine chemical and thin film coating technologies. The company was among the top 20 companies around the world granted U.S. patents in 2009, and in the year ended March 31, 2010, had global revenues of $23.5 billion*. Fujifilm is committed to environmental stewardship and good corporate citizenship. For more information, please visit www.fujifilmholdings.com.

** At an exchange rate of 93 yen to the dollar.*

Editorial Contact:
Edward Chrusciel
FUJIFILM Dimatix, Inc.
603-443-5364
echrusciel@dimatix.com

# # #