FUJIFILM Dimatix Drives Single Pass Inkjet Printhead Technology to Next Level at drupa 2008:
Molecular Fabrication Technology Enables 1200 dpi Precision

Introduction

SAMBA™ print engine technology builds on 20+ years cumulative history of inkjet knowledge. FUJIFILM Dimatix, Inc. (formerly Spectra, Inc.) entered the inkjet printhead business in the mid-1980s as an early developer of industrial piezo inkjet technology. The institutional knowledge that has been accumulated over these years, much of it through trial and error, has enabled Dimatix to put into place what can accurately be described as its most advanced drop-on-demand inkjet technology platform, forming the basis of its printing subsystems business for the next ten or more years.

Exclusively focused on the requirements of single-pass/fixed-array printing, Dimatix SAMBA technology introduced at drupa 2008 takes both the manufacturing process of inkjet printhead technology and the corresponding fluid deposition down to the molecular level. Jetting two picoliter droplets less than 1/6th the thickness of a human hair (which is 150 microns thick), with the unprecedented nozzle density for a piezo printhead of 2048 nozzles per square inch, the SAMBA printhead module features a native 1200 dpi resolution and operates at frequencies up to 100 kHz. The resulting building block will enable digital printing and deposition applications to reach both the speed and print quality necessary to open up the untapped opportunities in the world of print.

Technology

The beneficiary of Moore's law in the advancement of processing power and the development of nano-technology, the creation of SAMBA technology is attributable to the availability of new ultra high-precision manufacturing tools. The location of Dimatix's development and manufacturing facilities in Silicon Valley is likely to have been a catalyst in the accelerated development time, as the availability and service response time on the required high-technology manufacturing tools and equipment are found in few other areas of the world.

SAMBA technology does not replace Dimatix's prior generation products but moves the company upstream to higher value, more complete printing sub-systems, while at the same time complementing its existing inkjet printhead products as well as the company's new Q-Class printhead array and clusters (also announced at drupa 2008).

FUJIFILM Dimatix
SAMBA™ Print Bar Technology

FUJIFILM Dimatix SAMBA™ Inkjet Print Engine Technology

Model Name	SAMBA™
Nozzles/head	2048
Native resolution (dpi)	1200
Droplet size	0.1 to 2 picoliter
Firing frequency	variable, up to 100 Khz
Footprint of single head	< 2" deep
Print bar configurations	3.2” to 72”+; limited by data processing ability
Compatible Ink types	aqueous, solvent, UV-curable, oil, other
Ink viscosity range	5-10 centipoise
Voltage/nozzle	20-30 volt

Source: I.T. Strategies, Inc.

History

Before the company became FUJIFILM Dimatix, more than five years of development time had already been invested in the creation of its proprietary silicon MEMs-based printheads. MEMS technology, an abbreviation for microelectromechanical systems, relies on silicon thin film material rather than carbon for the creation of the printhead. The inherent characteristics of silicon allow the inkjet head to work under very little stress, allowing it to jet billions of droplets without failure. The benefits that silicon brought to the first generation of Dimatix’s silicon MEMs technology (M-Class inkjet printheads) were great stability in performance, smaller drop volumes and physical printhead size, improved print quality, and reliability.

SAMBA technology takes this to the next level by combining MEMs fabrication, VersaDrop™ technology and re-circulating ink technology. VersaDrop™ technology allows manipulation of the waveform of how the droplets are formed, allowing control over the amount of ink pumped into each droplet before it detaches from the nozzle. The benefit of the ability to change droplet size on the fly provides grayscale capability and additionally could be used to compensate for adjacent nozzles in case of failure. This would reduce the need for nozzle redundancy and improve the economics of printing systems that will deploy SAMBA technology.

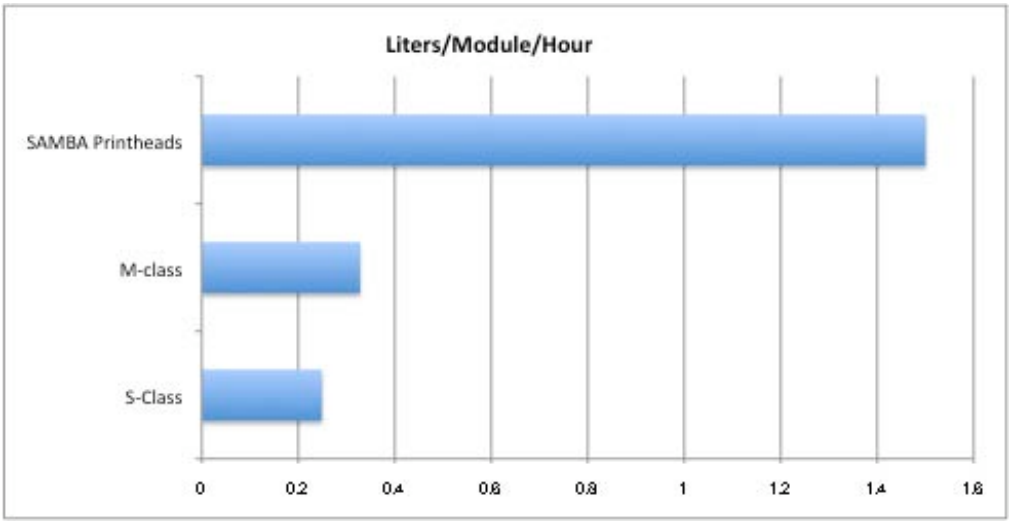
Molecular Bonding

The compactness of the SAMBA printhead module’s design is enabled by significant advancements in thin film manufacturing technology. With silicon MEMS manufacturing equipment investments close to 50% of Dimatix’s annual revenue, these highly specialized manufacturing tools allow levels of precision down to the molecular level. For example, the nozzle plate is bonded at a molecular level to the printhead chassis. The individual nozzle orifices are about 25 microns in size, so small that without magnification the human eye cannot see them. The nozzle plate of a single 2048 nozzle printhead indeed looks like a solid piece of material.

Performance Benefits

The density of the nozzles per SAMBA printhead module is starting to rival thermal inkjet technology. When implemented across a large single-pass print bar, this lowers the complexity of integration by greatly reducing the number of inkjet printheads needed. For example, if a press design that uses 1,000 S-Class inkjet printheads were to be exchanged for SAMBA technology, it would only need 62 SAMBA inkjet printhead modules to match the same number of nozzles. The integration of 62 printhead modules presumably is significantly simpler than the integration of 1,000 printheads.

On a liter per hour per printhead module basis, SAMBA printhead models are nearly 5X more productive than prior Dimatix generations. Aside from the greater nozzle density, the up to 100KHz firing frequency also enables this increase in performance.



Source: I.T. Strategies, Inc.

Business Model

One of the unintended consequences of developing higher precision silicon MEMs printhead technology is an across the board rising of complexity. So while the capabilities of the inkjet printhead are far greater in terms of performance, so is the need for greater capabilities in fluids, ink delivery, maintenance, etc. The first six OEM adopters of Dimatix's M-Class technology who invested in the learning curve of these higher precision inkjet printheads may have found it more challenging than anticipated, and all of them had the benefit of implementing the technology on a scanning chassis implementation rather than single pass array, where there is greater leeway for error recovery during printing.

The SAMBA technology is intended as a single-pass inkjet array technology, which means that the level of implementation expertise needs to be commensurately greater. To enable faster commercialization, Dimatix will only offer SAMBA technology to OEMs as a complete printing sub-system that incorporates the inkjet printhead clusters into a pre-manufactured print bar, and includes the drive electronics, data manager, fluid station, and Ethernet connection.

The fluid sets are expected to be wide ranging for the SAMBA printheads, in part because the viscosity range is significantly higher than most other drop-on-demand

inkjet printheads can fire. However, due to the small picoliter firing size, the fluids also have to highly precise. Dispersion for pigmented inks will have to be optimized to prevent conglomeration, which could result in variations on print quality. While no announcements have been made, I.T. Strategies expects FUJIFILM's 6,000+ chemists (not all ink jet chemists of course) will have paid some attention to fluid development for the SAMBA printheads.

Applications

As a technology supplier, Dimatix does not influence the applications that its OEM customers target when developing their printers. Natural applications for high-performance single-pass applications are digital color production document printing, label printing, and select packaging applications. Wide format graphics is technologically possible from a single-pass SAMBA printing sub-system perspective, but may be further in the future in terms of data processing requirements: processing 1200 dpi, photographically rich images at 72" wide may take more processing power than economically realistic for most printshops at this time, although this could be within reach after the turn of the decade.

Others applications that seem well suited to less than-two-picoliter droplets are micro-deposition applications in the area of backplanes, transistors, and OLEDs. Many of the first 400+ customers of the 16-nozzle DMP-2800 micro-deposition printers are candidates for an upgrade path to SAMBA technology.

Dimatix's parent company, whose core business is chemical manufacturing and who also owns 75% of the Fuji-Xerox Ltd, is likely to also play a greater role in the deployment of the SAMBA technology. While it is unclear what FUJIFILM's intentions may be, it has been assembling through mergers and acquisitions an arsenal of chemistry, inkjet printing systems, and distribution capabilities.

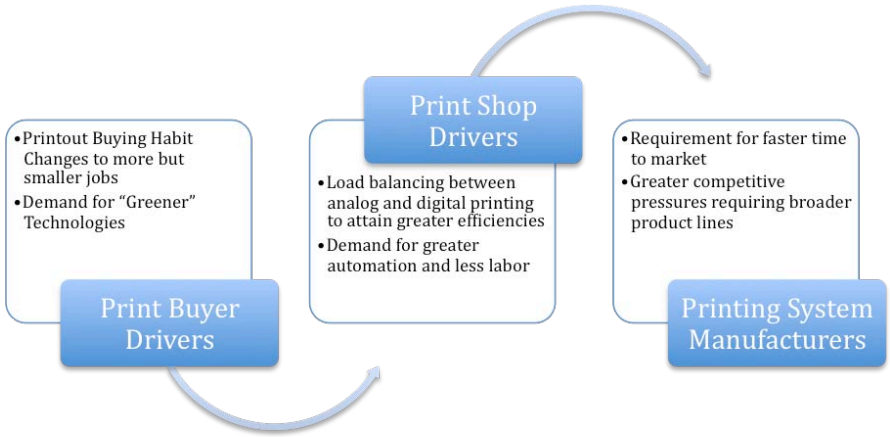
Implications: Putting SAMBA into Context

Complexity leads to simplicity. Due to the atomic levels of complexity in the manufacturing of the SAMBA printhead modules, and the resulting requirement for all other parts of the printing sub-system to be matched with similar levels of precision, the focus of resources in the development of a single-pass printing system have shifted in balance to a greater degree towards Dimatix than the printing system integrator.

Therefore, in theory, the integration burden of single-pass inkjet technology should be simpler and should enable the acceleration of a new class of production class printing systems to hit the market sooner. It may even lead to a new generation of inkjet printing system suppliers who will no doubt feel increasing pressure to offer digital printing technology after leaving drupa.

I.T. Strategies expects a confluence of market changing trends at the commercial print shop level. With print output buying habits changing quickly (competitive pressures are leading to even greater compressed turnaround, demand for flexibility, and application range extension), and growing demand for greener technologies (digital printing creates less waste than analog print), many of the traditional printing press suppliers will feel the pressure to offer digital printing solutions as well.

Market Dynamics Accelerating in Favor of Digital Production Printing



Source: I.T. Strategies, Inc.

It is not just document printing where those changing trends are at play. They extend to label printing, the creation of printed goods (such as electronic displays, etc), and many other markets. SAMBA technology is an early enabler allowing printing systems manufacturers to respond to these trends, and in ways that may have been inaccessible previously due to complexity and lack of knowledge.

FUJIFILM Dimatix existing business as a printhead component supplier isn't going away, and in fact is seeing rapid growth and product line extensions with the newest 256-nozzle Q-class printhead assembly introduction at drupa. Rather, SAMBA technology is extending the range of accessibility to inkjet technology to those printing system manufacturers who previously considered inkjet inaccessible.

The first SAMBA printing and/or deposition systems are expected to be introduced to market within the next 12 months.