CASE STUDY

Plasma Etch for Silicon Microneedles

Customer

Swansea University is a research-led institution with a focus on research collaboration with industry internationally - to drive economic growth, foster prosperity, enrich the community and cultural life of Wales and the wider global community. See http://www.swansea.ac.uk/

Background

Microneedles can be used for pain-free transdermal drug delivery (i.e. through the skin), cell sampling and other biomedical applications. While microneedles can be successfully manufactured from other materials including polymers and metals, utilising silicon offers the ultimate promise of full electronic integration with a semiconductor-based control or sensing devices within a single package.

SPTS and Swansea University have been working on developing DRIE and CVD processes to create a range of microneedle designs for over 10 years, and the technology is now ready for commercial exploitation in a number of biomedical applications. A new cleanroom facility has been installed within the University, with all the SPTS equipment required for microneedle production, and a spin-out company created to manage the sale and production of microneedles to potential clients.

OBJECTIVE

• Develop a flexible and cost-effective wafer-scale manufacturing route for producing a variety of silicon microneedle designs for different applications, with a view to full commercialization of the technology via a spin-out company.

SOLUTION

• Many years of research have been completed to understand/optimize the process capabilities and how to tailor specific needle shapes and type (e.g. solid/hollow).
• Swansea University are installing all necessary equipment into one cleanroom location for efficient manufacturing.

RESULTS

• Process developed which can produce sharp bevelled-tipped microneedles of different lengths, without changing needle diameter or die size (see Fig 1).
• Pre-clinical testing in progress for a number of applications including cell transfer and insulin delivery.
• Skin insertion tests show superior penetration to other microneedles.
• Spin-out company launched and ready to produce needles for customers.

“*This joint collaboration has resulted in a successful processing route for cost-effective high volume manufacturing, which can be adapted to a variety of microneedle designs. We are now excited to be entering the period of commercialization, and contributing to a host of biomedical devices which can make a real difference to patient care and treatment.” Prof. Owen Guy, Head of Chemistry & Director (Engineering) Centre for Nanohealth,

www.orbotech.com/spts
Fig. 1 Schematic of process flow for silicon microneedle manufacturing developed at SPTS/Swansea University

Fig. 2 Processed wafer containing many microneedle arrays

Fig. 3 Diced linear array of microneedles

Fig. 4 Microneedle array attached to industry-standard Leur Lock on a syringe

Fig. 5 Hollow silicon microneedles on wafer

Fig. 6 Vertical OCT tomographs of human breast skin treated with single silicon microneedles, showing clear stratum corneum brech

SPTS Technologies, an Orbotech company, designs, manufactures, sells, and supports etch, PVD, CVD and MVD® wafer processing solutions for the MEMS, advanced packaging, LED, high speed RF on GaAs, and power management device markets. For more information about SPTS Technologies, email enquiries@spts.com or visit www.orbotech.com/spts
Cautionary Statement Regarding Forward-Looking Statements

Except for historical information, the matters discussed in this press release are forward-looking statements within the meaning of the U.S. Private Securities Litigation Reform Act of 1995. These statements relate to, among other things, future prospects, developments and business strategies and involve certain risks and uncertainties. The words "anticipate," "believe," "could," "will," "plan," "expect" and "would" and similar terms and phrases, including references to assumptions, have been used in this press release to identify forward-looking statements. These forward-looking statements are made based on management's expectations and beliefs concerning future events affecting Orbotech and are subject to uncertainties and factors relating to Orbotech's operations and business environment, the previously announced acquisition of Orbotech by KLA, the manner in which the parties plan to effect the transaction, including the share repurchase program, the ability to raise additional capital necessary to complete the repurchase program within the time frame expected, the expected benefits, synergies and costs of the transaction, management plans relating to the transaction, including with respect to the Company's ownership interest in Frontline, the expected timing of the completion of the transaction, the parties' ability to complete the transaction considering the various closing conditions, including conditions related to regulatory and Orbotech shareholder approvals, the plans, strategies and objectives of management for future operations, product development, product extensions, product integration, complementary product offerings and growth opportunities in certain business areas, the potential future financial impact of the transaction, and any assumptions underlying any of the foregoing. Actual results may differ materially from those referred to in the forward-looking statements due to a number of important factors, including but not limited to the possibility that expected benefits of the transaction may not materialize as expected, that the transaction may not be timely completed, if at all, that KLA-Tencor may not be able to successfully integrate the solutions and employees of the two companies or ensure the continued performance or growth of Orbotech's products or solutions, the risk that the Company may not achieve its revenue expectations within and for 2018 (including, without limitation, due to shifting move-in dates); cyclicity in the industries in which the Company operates, the Company's supply chain management and production capacity, order cancelation (often without penalty), timing and occurrence of product acceptance (the Company defines 'bookings' and 'backlog' as purchase arrangements with customers that are based on mutually agreed terms, which, in some cases for bookings and backlog, may still be subject to completion of written documentation and may be changed or cancelled by the customer, often without penalty), fluctuations in product mix within and among divisions, worldwide economic conditions generally, especially in the industries in which the Company operates, the timing and strength of product and service offerings by the Company and its competitors, changes in business or pricing strategies, changes in the prevailing political and regulatory framework in which the relevant parties operate, including as a result of the United Kingdom's prospective withdrawal from the European Union (known as "Brexit") and political uncertainty in the United States, or in economic or technological trends or conditions, including currency fluctuations, inflation and consumer confidence, on a global, regional or national basis, the level of consumer demand for sophisticated devices such as smart mobile devices, automotive electronics, flexible applications and devices, augmented reality/virtual reality and wearable devices, high-performance computing, liquid crystal display and organic light emitting diode screens and other sophisticated devices, the Company's global operations and its ability to comply with varying legal, regulatory, exchange, tax and customs regimes, the timing and outcome of tax audits, including the best judgment tax assessment issued by the Israel Tax Authority with respect to the audit of tax years 2012-2014 in Israel and the related criminal investigation, the Company's ability to achieve strategic initiatives, including related to its acquisition strategy, the Company's debt and corporate financing activities; the timing, final outcome and impact of the criminal matter and ongoing investigation in Korea, including any impact on existing or future business opportunities in Korea and elsewhere, any civil actions related to the Korean matter brought by third parties, including the Company's customers, which may result in monetary judgments or settlements, expenses associated with the Korean matter, and ongoing or increased hostilities in Israel and the surrounding areas.

The foregoing information should be read in connection with the Company's Annual Report on Form 20-F for the year ended December 31, 2017, and subsequent SEC filings. The Company is subject to the foregoing and other risks detailed in those reports. The Company assumes no obligation to update the information in this press release to reflect new information, future events or otherwise, except as required by law.