SPTS
A KLA Company

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/**

Application

A joint development project between SPTS and Swansea was focused on utilising SPTS's plasma etch and deposition technologies to create silicon-based BioMEMS devices (notably microneedles), with a focus on production-scale commercialization of microneedle delivery devices.

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

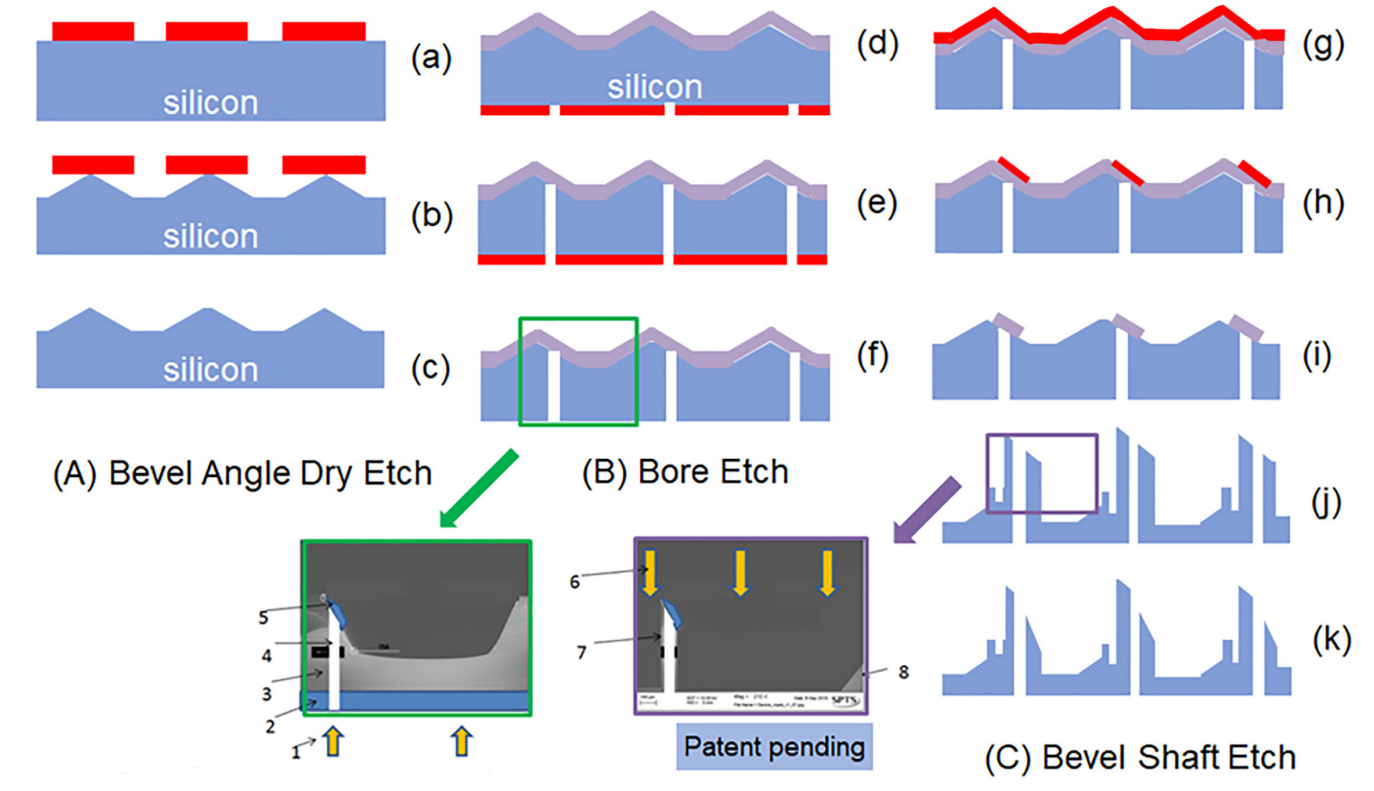

Fig. 1 Schematic of process flow for silicon microneedle manufacturing developed at SPTS/Swansea University

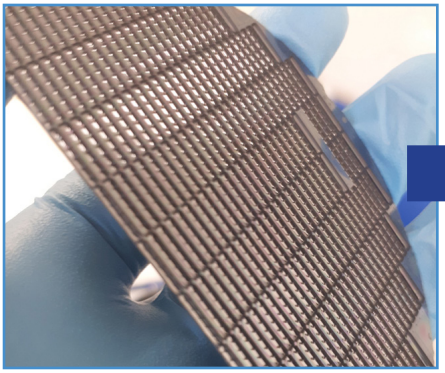

Fig. 2 Processed wafer containing many microneedle arrays

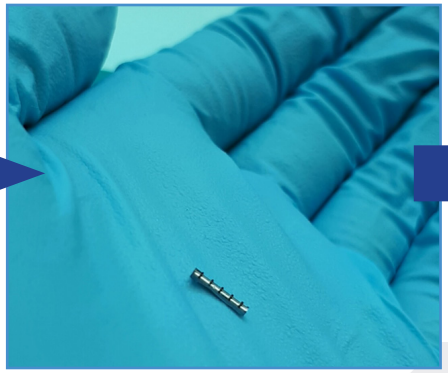

Fig. 3 Diced linear array of microneedles

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

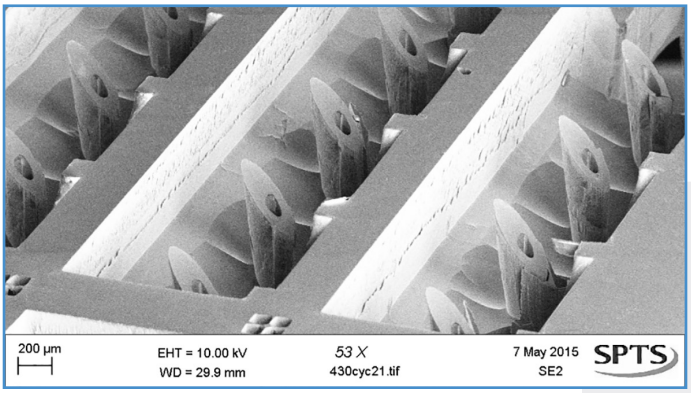

Fig. 5 Hollow silicon microneedles on wafer

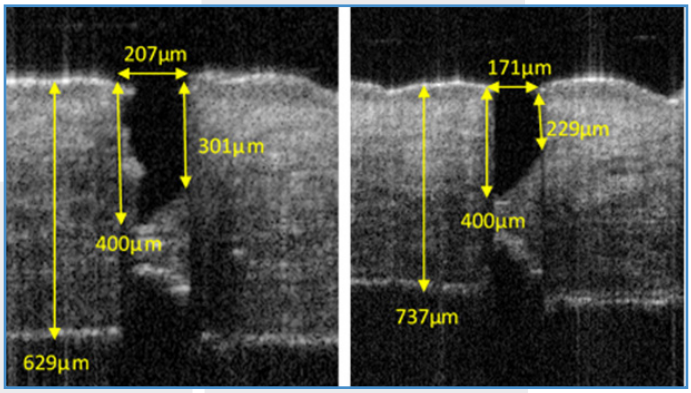

Fig. 6 Vertical OCT tomographs of human breast skin treated with single silicon microneedles, showing clear stratum corneum breech

SPTS Technologies, a KLA company, designs, manufactures, sells, and supports etch, PVD, CVD and MVD® wafer processing solutions for the MEMS and sensors, advanced packaging, photonics, high speed RF, and power device markets. For more information, email enquiries@spts.com or visit www.spts.com